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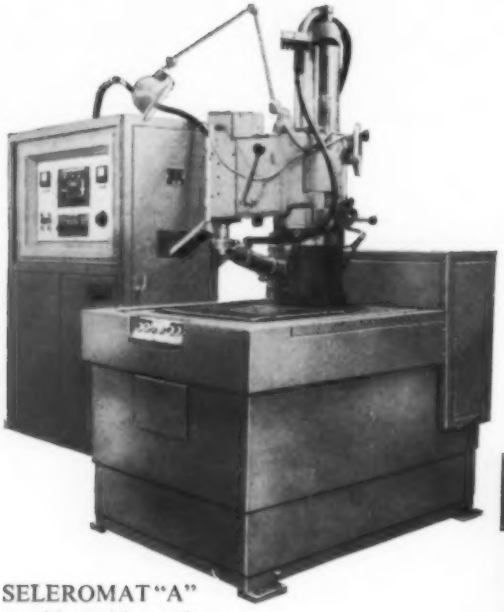
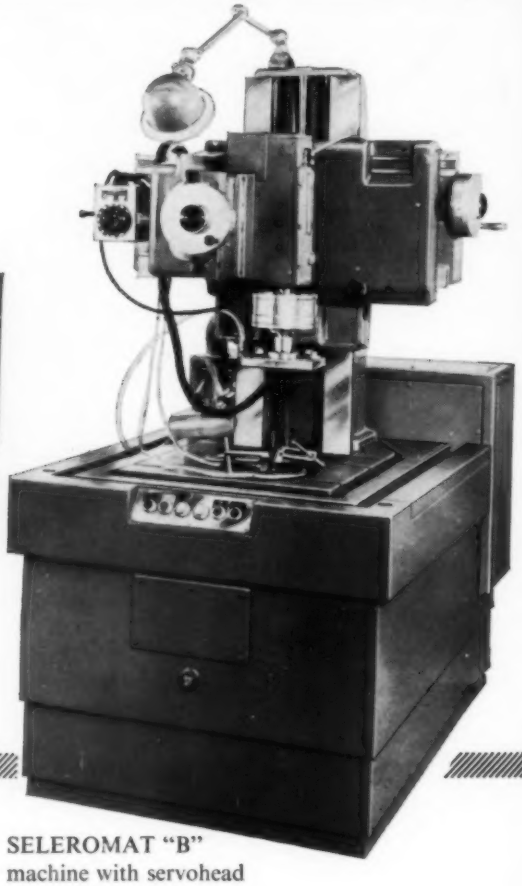


SELEROMAT "A" machine with spark generator



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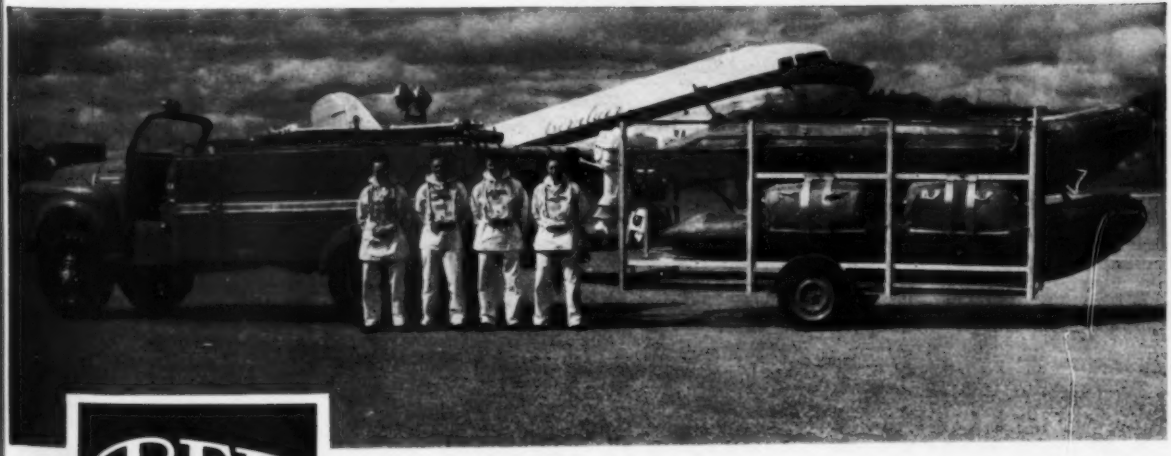

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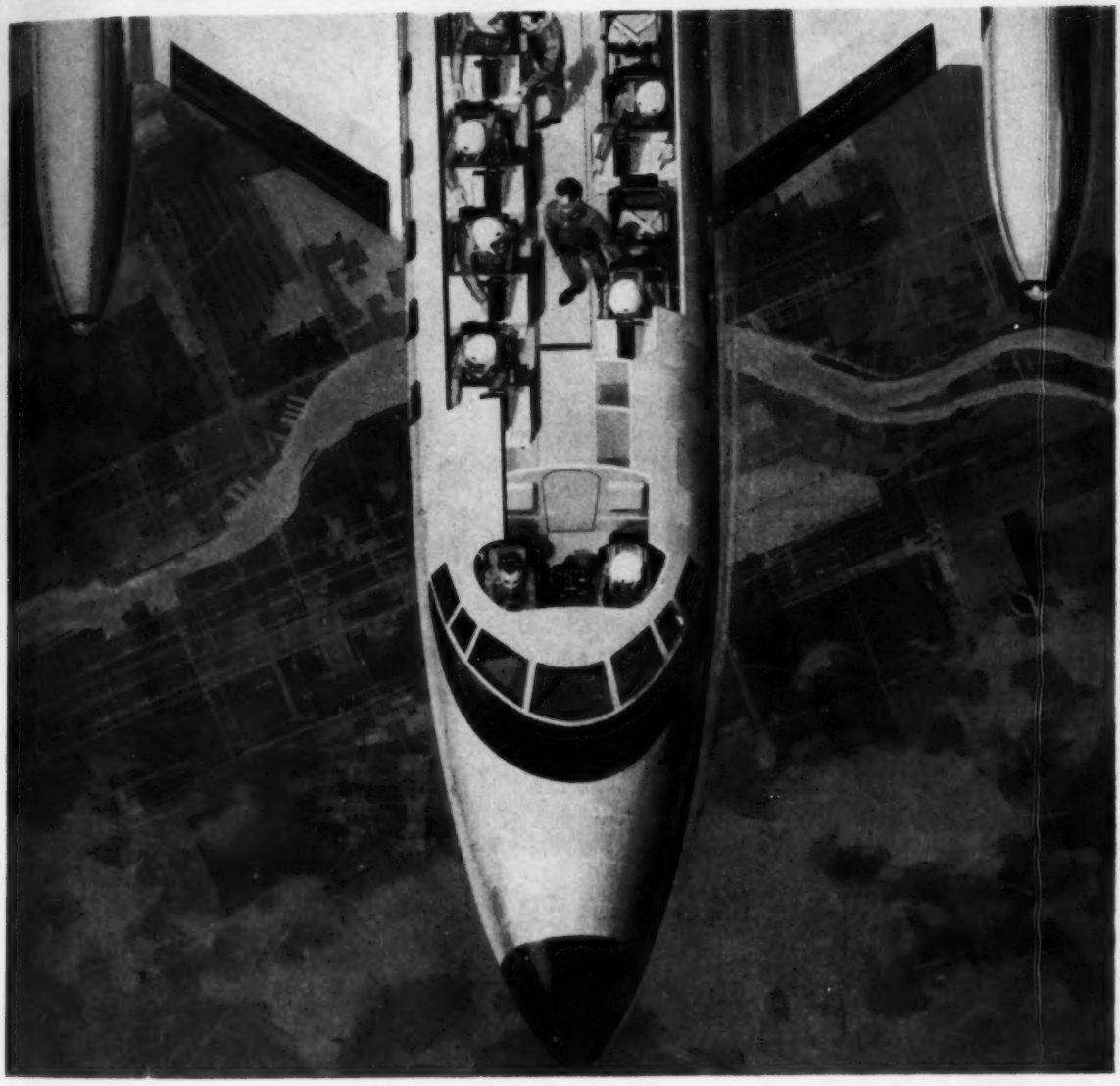

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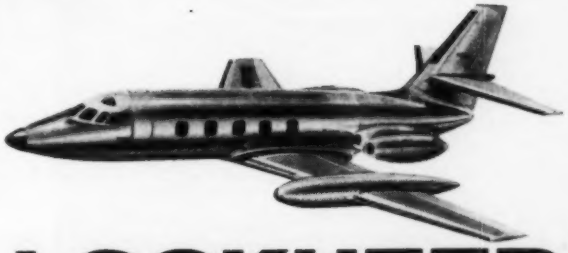

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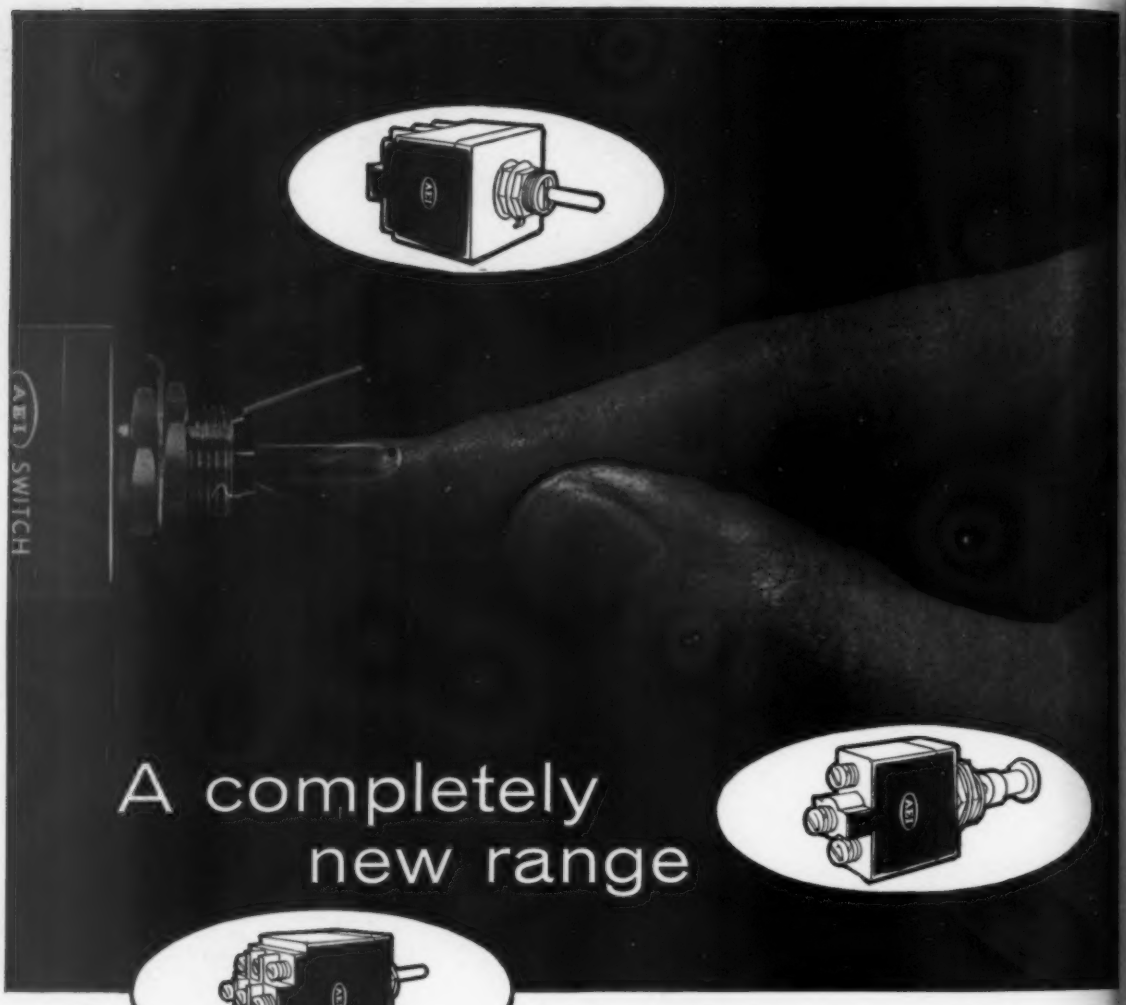

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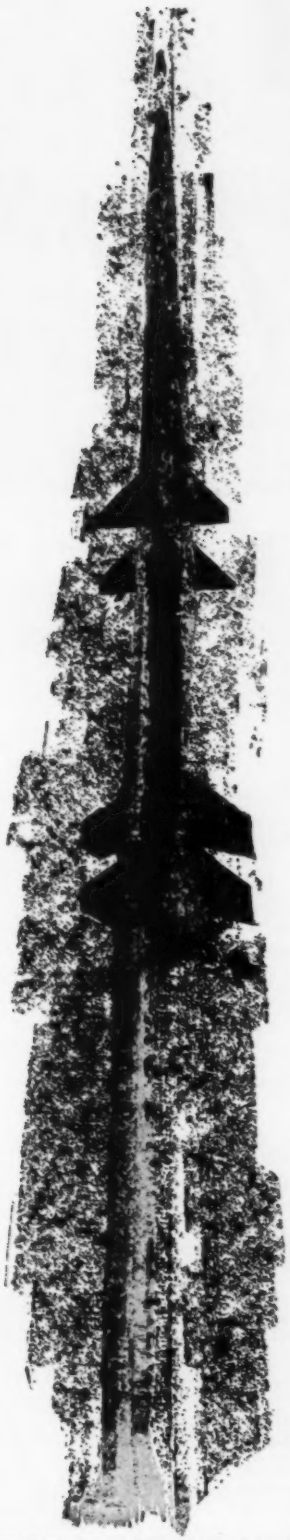

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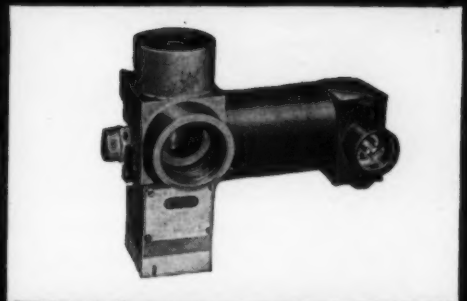

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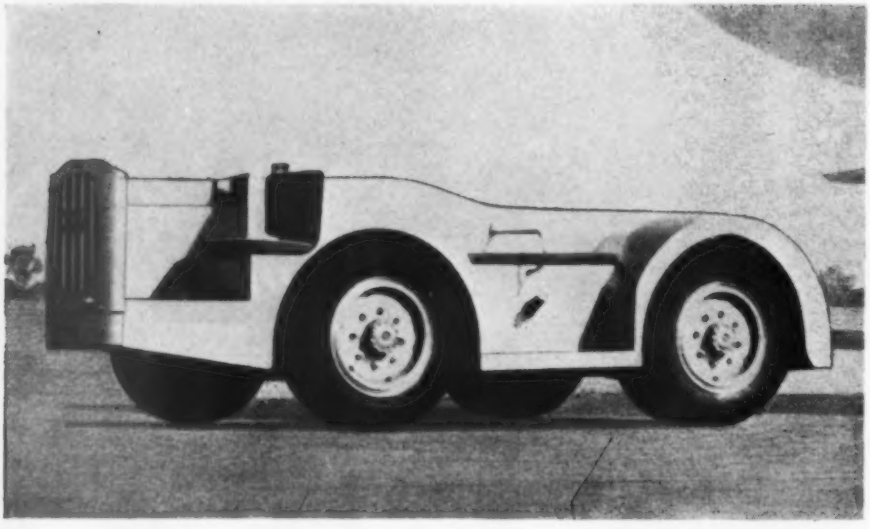

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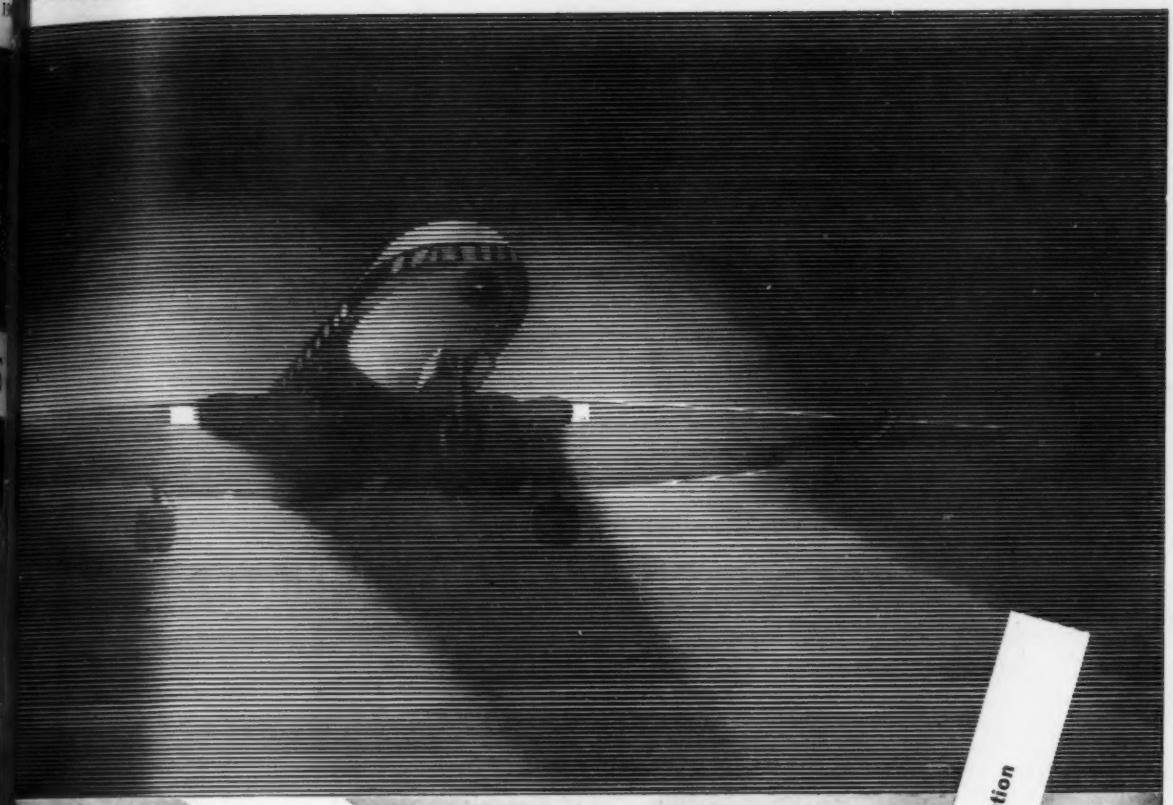

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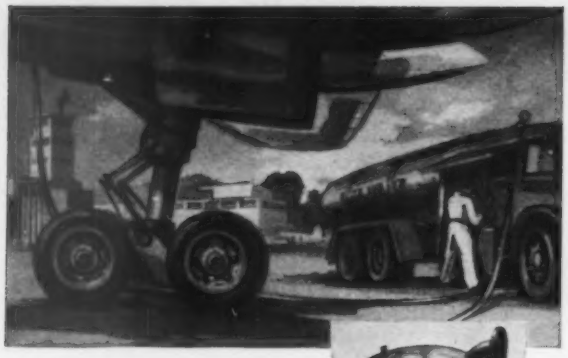

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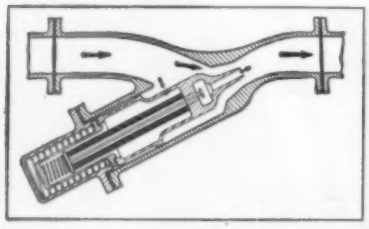

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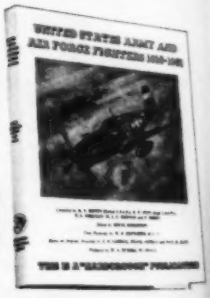

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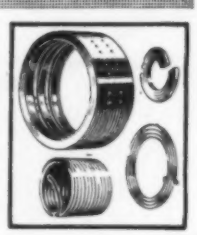

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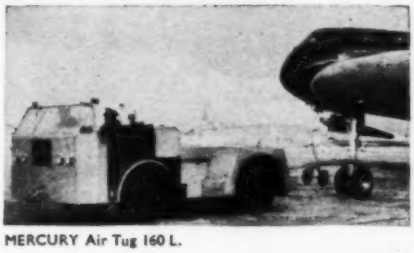

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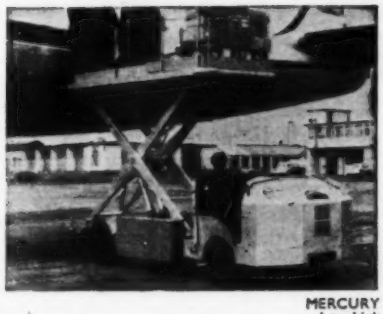

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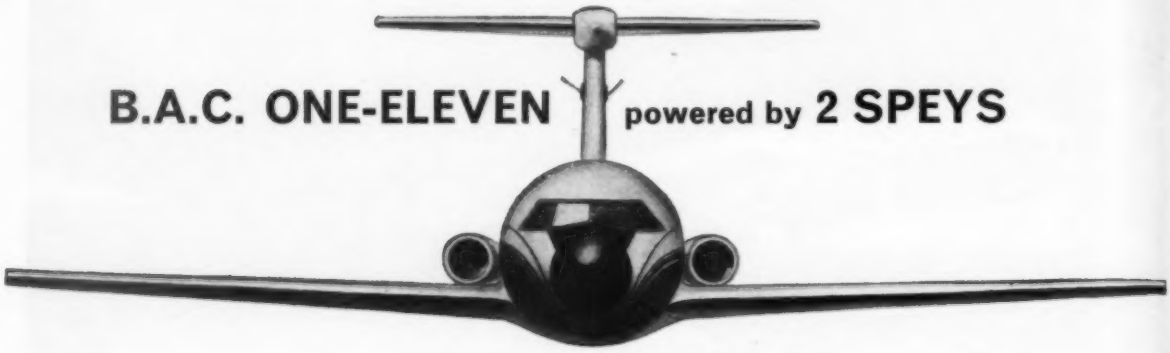

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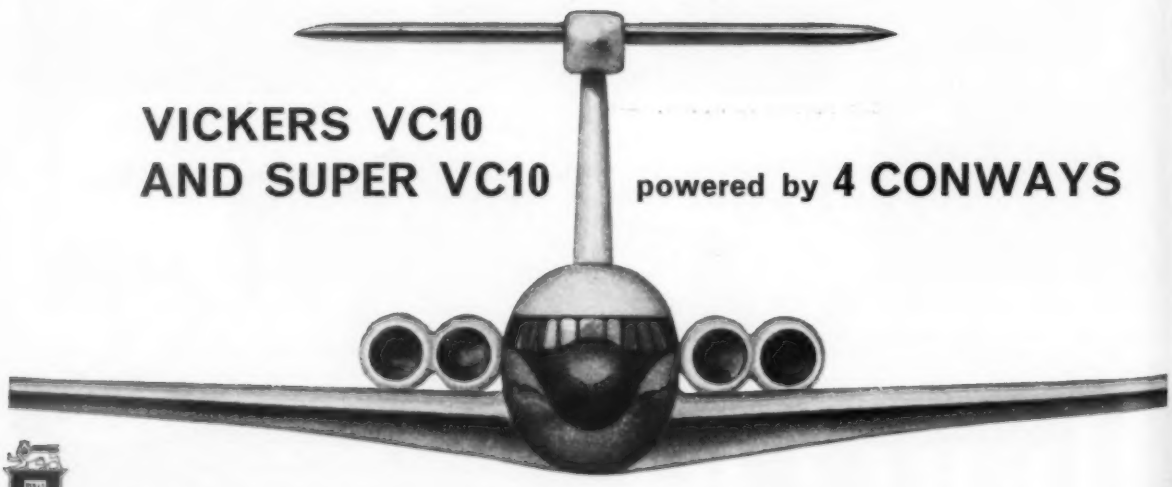

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New Approaches

AS a follow-up to the co-operation between British and Soviet scientists at Jodrell Bank, and as a new approach which might generate further co-operation in the future, the forthcoming visit to the Soviet Union by Blue Streak engineer Geoffrey Pardoe and television company director, the Earl of Bessborough, is to be welcomed. Equally welcome, in the Lords debate last week, was a suggestion by Lord Bessborough that private enterprise should raise some of the money needed to finance a communication satellite programme. Two other peers, Viscount Caldecote and Lord Fleck, both complained that no details of GPO thinking on communication satellites had been made public: perhaps the GPO may confide in the nation next year, when the Bell Telephone Laboratorie's Telstar will be among a number of orbiting US communication satellites using the GPO's ground station at Goonhilly Downs, Cornwall.

The Most

OF all the yardsticks whereby aeronautical progress is measured, speed records are probably the most significant and certainly the most dramatic. In post-war years they have assumed a special importance, for whereas formerly the laurels went to specially built racing or sprint aircraft, they have more recently been passing to military types.

The new world speed record of 1,606·342 m.p.h., set up by Lt Col Robert B. Robinson, US Marine Corps, in a McDonnell F4H Phantom II, calls for comment on several counts. In the first place the new speed mark represents an increment of almost exactly 1,000 m.p.h. since Gp Capt Wilson's historic performance in the Gloster Meteor 16 years ago (almost to the week). Another reason is that the highest speed attained on the record flight—some 1,650 m.p.h.—represents, at the stated altitude of 45,000ft, a Mach number of almost precisely 2.5. Third it must be remarked that an aircraft of the same type has already reached an altitude of nearly 100,000ft (actually 98,557). In the fourth place the Phantom II is probably the most effective manned bomber-killing system available today. It has, incidentally, two seats. A fifth, and especially notable, consideration is that this aircraft has exceptional capabilities in terms of range (its fuel capacity of 3,200 US gal is far greater than that of any comparable machine in the Western world). A sixth point is that it is, in its own right, a very potent bomber and attack aircraft, approaching the Lancaster in carrying capacity. Seventh, it is a carrier-borne aeroplane, burdened with all the attendant paraphernalia. In the speed context we might well have added that a Phantom II has averaged about 900 m.p.h. (M1.2) over a 3km course while flying at a maximum height of only 300ft.

On the engineering side the remarkable fact about the Phantom II is that, although its structure incorporates important areas of steel and titanium, it is far from being an all-steel aircraft like Britain's Bristol 188. Yet, as we have noted, it has flown at two-and-a-half times the speed of sound. This is well beyond the threshold usually ascribed to light-alloy aircraft.

We remember hearing at the Paris Show a famous aircraft designer declare that the Phantom II is the outstanding example of brute force and ruddy ignorance; and certainly it bears more resemblance to a meat axe than to a rapier. But as an example of aeronautical engineering in the seventh decade of the twentieth century the new world-record holder is, as its compatriots might put it, the most.

FROM ALL QUARTERS

MoA Hovercraft Research Programme

A RESEARCH programme on hovercraft is being instituted by the MoA at RAE Bedford, "in order to assist in the Ministry's evaluation of the possibility of using hovercraft to meet military requirements." To ensure as rapid progress as possible the Ministry is purchasing from Cushioncraft Ltd the recently completed CC.2 experimental air cushion vehicle to assist in the research programme. The RAE are also being assisted with the research programmes on SR.N1 and the forthcoming programme on the SR.N2.

The MoA announcement also states: "the Ministry is continuing to follow closely the work which is being done in the development of hovercraft by Hovercraft Development Ltd and the companies associated with it. Hovercraft Development Ltd will also be associated with the RAE research programme."

More Comets For Egypt

AS forecast in *Flight* for November 23, page 796, United Arab Airlines has ordered two more Comet 4Cs to increase its fleet from five to seven. The contract was signed in Cairo on December 9. The two aircraft will be delivered in April; this brings the value of UAA Comet purchases to more than £8m. Total number of Comet 4s, 4Bs and 4Cs sold is now 66.

Strategic Transports Needed

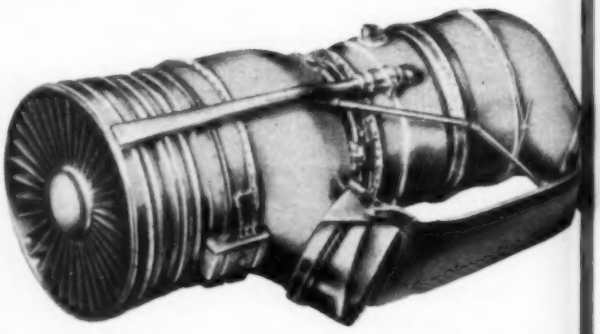
SPEAKING at a luncheon given by the Air League of the British Empire at the Mansion House on December 7, Lord Mountbatten of Burma, Chief of the Defence Staff, who was guest of honour, said that whatever our plans for the future, we should have to have strategic transport aircraft to match the challenge of fewer bases and increasing stage lengths. "Against the political future," he said, "I suggest there is no room for complacency about types or numbers. The longest stage on an entirely Commonwealth route is that from Vancouver to Christmas Island—3,600 miles. When will we have an aircraft which can take such a distance in its stride at a worthwhile speed? The experts must answer the questions of load and speed, but with regard to the latter I sometimes think there is a danger of getting the speed parameter out of perspective. The old saying 'more haste less speed' could well apply if we go for too much speed at the price of space and payload. Thus the subsonic laminar-flow solution might well be preferable to a supersonic military transport. It would presumably be less expensive and more likely to have the flexibility of range and payload required."

BS.100 Revealed

DURING the past few months unofficial reports have spoken of a new Bristol Siddeley lift/thrust turbofan, said to be designated BS.100 and to have a rating of the order of 38,000lb. It is said to be the powerplant of the projected Republic/Fokker D-24 Alliance variable-sweep entry in the NATO BMR-3 competition. Now the first wraps are off; the current issue of the *Bristol Siddeley Journal* contains an artist's impression (reproduced in column 2) of the projected engine, and discusses it in general terms.

This disclosure shows that there is no British Government money in the project, although the BS.100 is undoubtedly one of the most significant engines in the world. It would be logical to assume that its design is based upon that of the Olympus 21, although the front end comprises a fan with two or three stages of the longest blades ever seen. Assuming a by-pass ratio of around 1.3, the total mass flow must be considerably more than 600lb/sec, or four times the flow through an Avon. Bristol Siddeley comment on the use of "plenum chamber burning," in which combustion within the by-pass duct is used to give nearly treble the thrust at M2, for a modest increase in consumption and without ill effect on the rotating nozzles.

ROYAL VISITOR to the Pathfinder Association last Thursday was Her Majesty the Queen Mother, seen here with (left to right) AVM D. C. T. Bennett, who commanded the Pathfinder Force, and two members of the association, Mr R. A. Wellington and Mr L. G. Johnson. They are looking at a photograph of a visit paid by the Queen Mother and the late King George VI to Wyton in 1943 when they met Sqn Ldr Wellington's crew, of which Mr Johnson was a member. At the association's headquarters the Queen Mother was presented with a Pathfinder badge brooch



TO LIFT 30,000lb: Artist's impression of the BS.100 (see text)

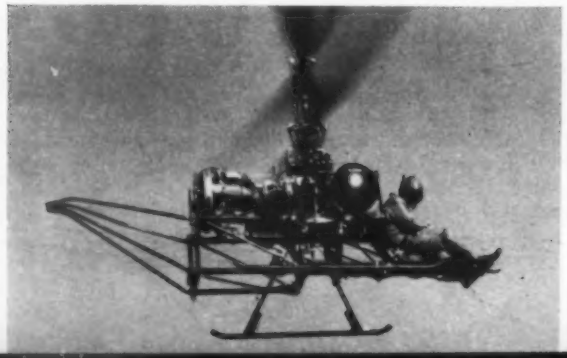
It is logical to suppose that PCB will be incorporated in the D-24 powerplant, and it may well be a feature of the sketch—for its presence or absence may be betrayed only by minor changes in duct profile and the addition of extra fuel galleries. The real puzzle concerns the long deflector plate hinged to the shroud around the forward (fan) nozzle. This can be moved by a jack about an axis forming a diameter of the nozzle, to place the shroud outside the jet.

Gift From Patuxent

A NEW trophy, the Patuxent Shield, was presented to the Empire Test Pilots' School last Thursday. Donated by the Naval Air Test Center, Patuxent River, Md, it was handed over during the annual McKenna Dinner at Farnborough by Rear Admiral Noel Gaylor, USN Air Attaché in the United Kingdom, on behalf of Rear Admiral P. H. Ramsey, Commander of the Center. The ETPS Commandant, Capt K. R. Hickson, RN, referred to the "wonderful liaison" which had always existed between the school and Patuxent River. The shield is being awarded annually to the runner-up to the McKenna Trophy.

Last Thursday's dinner marked the graduation of 20 Course, which Capt Hickson described as "better than average" (an epithet which occasioned the presentation by "Chris" Wren to the course of an aeronautical Yogi Bear). The McKenna Trophy was won by Flt Lt C. C. Rustin and the Patuxent Shield went to Flt Lt J. E. C. Mayes, who received it from Admiral Gaylor. Flt Lt P. J. Farris gained the Edwards Trophy (for the student who makes the most progress), and Lt H. W. A. Deacon, RN, was presented by Sir Sydney Camm with the Hawker Hunter Trophy for the best preview handling report.

AVM D. W. R. Ryley, who presented the McKenna and Edwards awards, paid special tribute to Capt Hickson on the latter's departure from ETPS to become Captain of RNAS Arbroath—



DASH, standing for drone anti-submarine helicopter, describes the mission of the DSN-3, the latest in a series built for the US Navy by the Gyrodyne Company of America. The DSN-3, powered by a 270 h.p. Boeing T50 turboshaft, is designed to carry homing torpedoes from the decks of destroyers. The picture was taken during initial (piloted) trials

PHOTOGRAPHIC SORTIE in a Hunter T.8 with Blackburn Buccaneers of 700Z Flight. Pilot of the Hunter is Cdr A. J. Leahy. For some of the results see pages 898 and 899

saying that "if he goes on in the same way as he has gone on at the school he is going to do well." Sir Sydney Camm expressed "the tremendous debt we in the industry owe to test pilots" and asserted that since the 1957 Defence White Paper we had been "losing our position in the world race of aviation," adding that we in this country should be flying fighters or fighter-derivatives "at a Mach number of about 3."

Sopwith Apprentices Presentation

AT the seventh annual reunion dinner of the Sopwith Apprentices Association—held at the Royal Aero Club on December 5—a magnificent silver tray, carrying the signatures of the original directors of the Sopwith Aviation Co and the present Hawker Aircraft directors, was presented to Sir Frank Spriggs by the association's president, Sir Thomas Sopwith. The chairman, Mr R. W. Sutton, presided and a record number of guests attended. Barry Pegram, the best apprentice of 1961 and the only one ever to pass all his subjects with exceptional merit, was awarded the Hawker Apprentices Trophy and has been invited to join the association.

Beagle Sales Director

Wg Cdr T. Vigors

THE appointment of Wg Cdr T. A. Vigors, DFC, as sales director of the Beagle group, from February 1 next year, has been announced. Until recently managing director of Vigors Aviation of Kidlington, Oxford, Wg Cdr Vigors is a well-known figure in the light aircraft world and over the past two years has had a remarkable sales success as agent for Piper aircraft in Britain and Eire. Beagle state that his new appointment "does not imply any disagreement with his former Piper colleagues. Wg Cdr Vigors is simply happier to be able to devote his efforts to selling British aircraft now that such a range as the Beagle pack is available to world markets." Retiring from the RAF in 1946 after a distinguished wartime career as fighter pilot and squadron and station commander, Wg Cdr Vigors became managing director of Irish Air Charter in 1956 and of Vigors Aviation in 1959. His resignation from Vigors Aviation (though he remains on the board in an advisory capacity) was announced in *Flight* for November 30.

GATCO Dinner Daniels

CRITICISMS of what he called "stone age" ATC equipment, and of restrictions on the use of UK airspace, were made by Philip Wills at the Guild of Air Traffic Control Officers' London Lodge annual dinner last Friday. Mr Wills, chairman of the British Gliding Association, said in proposing a toast to the Guild that during the war the Air Transport Auxiliary had ferried over 4,000 aircraft without radar yet without collisions; a thousand machines in the air over London had been "our overcrowded sky": nowadays, he said, this term was applied to four aircraft between London and Manchester (describing the latter's control zone scornfully as "that Sahara").

In Mr Wills' view, airspace restrictions were an attempt to make up for lack of equipment: as a result of them, our pioneer position in flying had been lost to other countries. We had been told we couldn't have the equipment until we had the aircraft to use it; but until we got the equipment "we must have freedom to fly." In gliding, we had managed to retain a degree of freedom, and this had helped to make us the leading gliding country in the world. British sailplanes had been the only British aircraft sold to Russia; and by self-discipline the gliding movement in the UK had set up standards of safety.

Mr Wills was not the only Daniel in the lion's den at the dinner, for another guest was Mr Reader Harris, MP, who admitted that his campaign for a reduction in aircraft noise had earned him the epithet "the most hated man around London Airport." Mr Harris said that if Mr Wills had been surprised to receive an invitation to the dinner, he himself had been "more than surprised"; and he added that after what he had heard from Mr Wills about ATC equipment he vowed never to fly from London Airport again.

Mr John Toseland, master of the London Lodge, said that aviation interests were many but had two rights in common: to navigate the air without collision,and as economically as possible. The Guild, whose membership was drawn from a wide field, had a voice and that voice would be heard—or neglected at cost.

IN BRIEF

The Minister of Aviation, Mr Peter Thorneycroft, said in a written Parliamentary reply on December 4 that an order for the Westland Rotodyne for the Royal Air Force was "under consideration."

The visit by the Air Minister to RAF Finningley last Friday to fly in a Vulcan B.2, referred to on the Service Aviation page (page 910), had to be postponed owing to pressure of official business.

Westland Aircraft have engaged Mr C. H. Latimer-Needham, MSC(Eng), DIPENG, FRAES, AFIS, as a consultant. His appointment is concerned primarily with ground effect machines.

As forecast last week, Ryan have received a subcontract from GE to build two 450kt US Army research aircraft powered by twin J85-5 turbojets with diverter valves to lift fans in the wings. The first flight is scheduled for May 1963.

A new company, Air Sales (Oxford) Ltd, has been formed which will act as Piper agents, operating from Oxford Airport, Kidlington. Managing director is Miss M. O'Reilly, formerly with Vigors Aviation, and directors are Messrs Max Conrad and J. A. Ansell.

The US Department of Defense are to purchase a Boeing 707-320B for the personal use of the President. Powered by the Pratt & Whitney JT3D turbofan, it has a greater payload/range performance than any other airliner in US service.

The first RAF Lightnings to be stationed in Europe arrived on December 6 at RAF Gutersloh in Germany. The six aircraft concerned, from 111 Sqn, are to stay at Gutersloh for an indefinite period as part of a scheme for Fighter Command units to gain NATO experience.

Live drops made from a Whitworth Gloster Argosy at A & AEE Boscombe Down have shown the aircraft to be, in the company's words, "an excellent jumping platform." The first two men to jump from the Argosy were Flt Lt B. W. Rigold and Flt Sgt B. Lambirth.

The first three Westland Gnome-Whirlwinds recently delivered to the RAF at Odiham for intensive flying trials with 225 Sqn have already completed the first stage in their scheduled programme. Starting on November 6, three of these aircraft have each completed their first 100hr flying, averaging five hours per day since flying started.

Fiat and Sud-Aviation have signed an agreement with Chance Vought in support of the latter company's entry in the NATO NBMR-4 V/STOL transport competition. The design is based upon the Vought/Ryan/Hiller tilt-wing which won the US "Tri-Service" competition, and the two European firms will share manufacture should it win NBMR-4.

Two Pioneers of 209 Sqn, based at Seletar, Singapore, recently made unarrested deck landings on HMS *Bulwark* off the east coast of Malaya. This is thought to be the first occasion since the Norwegian campaign of 1940 on which RAF fixed-wing aircraft have made deck landings. For the tests, wind speed was reduced to 10kt. The first aircraft to land was flown by the commanding officer, Sqn Ldr J. Cartwright.

The first Belgian-assembled Lockheed F-104G flew from the Avions Fairey/SABCA airfield at Gosselies on December 4. As described in our review of the programme on October 19, this is the first of 194, including 30 assembled from parts shipped by Fiat. The first Northern Group F-104G flew from the Fokker airfield on November 11, and the first from the South Group flew from the new Messerschmitt field at Manching on August 10, 1961.

In a report of the inquest on Lt Cdr Oswald Brown and Mr T. D. Dunn, who were killed in a take-off accident from HMS *Hermes* on August 31, based on a news agency report (*Flight*, November 23), an opinion was quoted as to the pilot's handling of the aircraft. From further information which has become available, it should be stated that, although it was thought possible that Lt Cdr Brown might have been distracted momentarily by an extremely loud warning-bell sounded at the moment of take-off, there is no suggestion of pilot error or negligence. A verdict of misadventure was recorded, and Treasury counsel expressed great regret at the loss of such an experienced and valuable test pilot.

"... we jo

TAKE A BRACE of Blackburn Buccaneers and a Hunter Two-seater, splice with the skill and verve of three of the Royal Navy's most experienced pilots, invite aboard a *Flight* photographer, and some of the exciting results are as seen on these two pages. Pilot of the photographic Hunter was Cdr A. J. Leahy, MBE, DSC, who commands 700Z Flight, the Buccaneer intensive flying trials unit, at RNAS Lossiemouth. Flying the Buccaneer seen in a LABS manœuvre at left, with dramatic wing-tip trails, was Lt Cdr E. R. Anson, the unit's Senior Pilot. In the tail-chase depicted at right, with Lt Cdr Anson hotly pursued by Lt B. R. Toomey, the Buccaneer's area rule and dive-brake tail-section are much in evidence.

"Flight" photographs by Ian Macdonald

ilor boys were up, up, aloft . . .”

Among those at the British Air Line Pilots Association cocktail party at Londonderry House on December 6 were, left to right, Sir Robert Perkins, BALPA's vice-president; Mr Myles Wyatt, chairman of British United Airways; and Lord Balfour of BEA ("*Flight*" *photograph*)

AIR COMMERCE

BEA WILL APPEAL

BEA has decided to appeal against some, though not all, of the Air Transport Licensing Board's decisions awarding 22 new routes to British United, Cunard Eagle and Starways (see *Flight* last week). The corporation has 21 days in which formally to lodge its appeal, this period being dated from the publication of the decisions on December 6.

The grounds on which BEA will appeal are a matter for speculation; obviously the corporation will have taken note, in the light of the recent BOAC *v.* Cunard Eagle appeal, of the passage in the Board report which says that, on the assumption that BEA's traffic estimates are correct, "it will be the case that they [BEA] will have a few aircraft too many." The Board says that this surplus, "if it arises at all," will not necessarily lead to the procurement of fewer Tridents.

Are the independents likely to appeal? Last week British United, Cunard Eagle and Starways—all of whom were awarded considerably less than they applied for—said, in effect, that the ATLB's report was still being studied. According to the Board, the routes awarded to the independents would justify the use of about six aircraft of BAC One-Eleven capacity. This would be three or four in the case of BUA and two or three in the case of Cunard Eagle.

Last week Mr Myles Wyatt, chairman of British United, sent a letter to MPs setting out the facts about the licensing situation, and drawing attention to BUA's good financial and safety records.

Footnote: It is understood that British Railways are to appeal against the ATLB's decision to allow BEA's three-guinea Vanguard night services to Glasgow and Edinburgh (which have actually been in operation since November 1). The railways will not appeal against the London-Belfast three-guinea fare. It will be recalled that the Minister, in a recent appeals decision, upheld the railways' contention that the ATLB should take into account diversion from surface carriers—though the ATLB, in its subsequent European case report, saw no reason why the prospect of such diversion should deter it in the exercise of its primary function "to further the development of civil aviation."

TOO MANY BOAC AIRCRAFT

IF, as now seems likely, BOAC's loss in 1961-62 is more than £10m, the corporation will have lost about £5 on each of the 4½m passengers it has carried since 1954-55. The current year's results are likely to be twice as bad as the worst (1958-59) since Government subsidies ceased ten years ago.

BOAC's plight, which is due to over-capacity, is no less grave for having been foreseen four-and-a-half years ago. It was clear that BOAC had ordered too many aircraft—even assuming an average annual 15 per cent traffic-growth: "*In 1962, if traffic grows at the average world rate, BOAC will find themselves with 35 per cent too much capacity—even assuming that all Britannia 102s and DC-7Cs are sold by 1962*" (*Flight*, June 7, 1957). The fact that traffic-growth has fallen considerably short, particularly during the current year, has aggravated what might in any case have been a serious situation.

BOAC's managing director, Sir Basil Smallpeice, tells staff in the current edition of *BOAC News* that the corporation is more than £8½m worse off than in the budget prepared last March. A loss of £2½m revenue is attributed to the strike in July, and revenue since April has been below budget by as much as £6½m, largely due to the shortfall on the Atlantic. World-wide passenger load factor has been 52 per cent compared with 58½ per cent budgeted. The only cheerful news is that BOAC's expenditure has not exceeded budget.

The analysis from which the above extract is taken predicted 70 per cent too much BOAC capacity in 1965, assuming disposal of all the corporation's Britannia 102s and DC-7Cs. Since that date BOAC has ordered an additional three Boeing 707s and has changed an order for 35 VC10s to include 20 of greater-capacity Super standard, and has ordered ten more Super VC10s in addition. BOAC will have to find truly prodigious amounts of traffic if results more disastrous than those in 1961-62 are to be averted.

US SUPERSONIC TRANSPORT BY 1967?

THE Americans are hoping to have a prototype supersonic airliner flying by 1967, according to Col Rochte, chairman of a joint Government committee studying SST development, in an address to a conference in Washington on high-speed airworthiness requirements sponsored by the FAA, USAF and NASA.

Col Rochte suggests the following schedule for a supersonic airliner: research completed and contractors chosen by 1963; construction started by 1964; first test flight in 1967; certification and start of service by 1970. The aircraft would be Mach 3, and would cost as much as $500m (£178.5m) to develop to the prototype stage, compared with the $112m (£40m) needed for the Douglas DC-8. Col Rochte feels that a Mach 2 aircraft would be "merely an interim model." In addition to problems like the sonic boom and the need for new heat-resisting metals and alloys, says Col Rochte, a new engine is needed which will be as efficient at 5,000ft as at 50,000ft, and variable-sweep wings will have to be developed.

Footnote: Anglo-French negotiations on the joint development of a supersonic airliner were taken a stage further in Paris on December 7 when Mr Peter Thorneycroft met M Buron, the French Minister of Public Works and Transport, to discuss "matters of common interest." The two Ministers have agreed on the next steps to be taken and will meet again early in the new year to decide how to proceed further on supersonic collaboration.

CHEAPER ATLANTIC FARES?

MAJOR North Atlantic carriers began conferring privately in Bermuda on Monday in an attempt to agree on cheaper fares. Among the proposals expected to be discussed is one for a group fare for parties of 30 or more passengers, to lure back to the scheduled services the many thousands of passengers who now organize themselves into parties to charter aircraft at cheaper rates. Nearly 200,000 people are believed to have crossed the Atlantic by this means in the current year.

Another proposal to be discussed is for an individual excursion return fare of about £130, valid for between 16 and 23 days and available throughout the whole year, except at weekends. This proposed fare compares with last summer's cheapest scheduled fare of £154 7s on propeller driven aircraft and £173 15s by jet. The present 17-day excursion fare of £114 16s, which has been quite successful in boosting traffic after a slack summer, is available only between October and March.

ARGOSY MILESTONE

WITH two of its three Argosy freighters delivered, BEA began regular all-freight services with this type on December 1 with a flight to Milan. This service is being operated four times weekly, and on Tuesday of last week twice-weekly services to Paris and Jersey began. Following delivery of the third aircraft this month, all-freight Argosy services to Düsseldorf and Frankfurt (six times weekly), Manchester (five a week), Glasgow (three times a week) and Copenhagen (six times a week), will begin next month.

In introducing the Argosy, which it plans to use for an average of 2,000 hours per aircraft each year, BEA offers an increase of 1,500 per cent in the maximum permissible bulk of individual freight items. The top limits are now 6ft 8in × 8ft 4in × 46ft—no less than the overall size of the Argosy's hold, and a far cry from the 2ft × 5ft × 17ft limits imposed by the door size of the Pionair Leopard freighters previously used.

Airborne Aviation Service (Gatwick) Ltd are operating this high-lift aircraft-loading truck, a Commer Cargo-Lift supplied by Rootes Ltd. It is seen beside a DC-4 of Trans Atlantic Airlines at Gatwick. The special bodywork is mounted on a scissors-action sub-frame activated hydraulically

BREGUET 941 PERFORMANCE

THE Breguet Br 941 unpressurised STOL transport prototype has, in recent landing tests at Toulouse-Blagnac, given a foretaste of the possibilities of this military transport's commercial development, the pressurised Br 942.

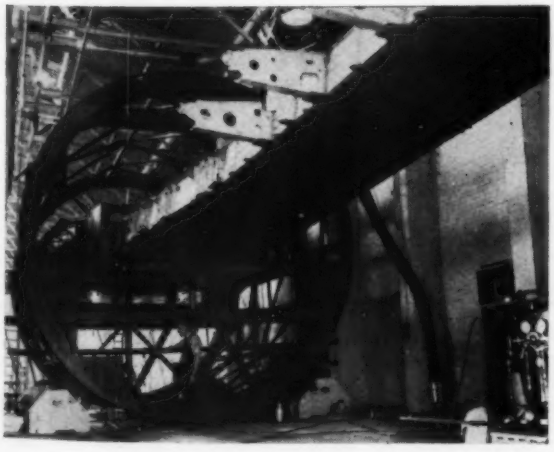
At a total weight of 16 tons, landing distance from 50ft was only 688ft, of which 311ft were for taxying. This remarkable performance, which was bettered by over 30ft at a weight of 17 tons, comes well within the guaranteed contractual distance of 787ft and was obtained, it is said, under far from ideal conditions. A take-off ground run of 524ft has been achieved at a weight of around 17.5 tons, and a total take-off distance of 787ft to clear a height of 10m (32.8ft). This performance will be considerably improved with production aircraft, which will have a total of 6,000 s.h.p. available at take-off from their four Turmo IIID turboprops.

BKS IN TROUBLE

THE latest independent in financial distress, and to have been placed in the hands of receivers, is BKS Air Transport, one of the largest and best established of the private UK operators. A BKS statement says: "The purely financial difficulties correspond with the difficulties currently being experienced by the industry as a whole. But plans are being made to ensure that summer services are flown for 1962 and we look forward to a continued increase in traffic carried." Two chartered accountants, Mr J. B. Sweeney and Mr A. G. W. Scott, have been appointed joint receivers and managers by the airline's bankers and will act as agents of the company in full co-operation with the existing management.

BKS operated more passenger-miles on domestic routes than any other independent this year and recently introduced a novel "Book Now-Schedule Later" scheme for the Leeds/Bradford - Channel Islands route (see *Flight*, October 12). BKS recently withdrew its twice-weekly Leeds - Rotterdam - Düsseldorf service because it was proving uneconomic, but is believed to have been planning on introducing its Avro 748s, of which it has five on order, into service on April 15, 1962.

It is not known whether the Avro 748 order is in jeopardy, but there is to be no change in the airline's flying programmes, which continue as before, and in a circular to creditors the receivers ask them to continue supplies and services on normal credit terms. There would be no alterations in existing maintenance, safety and insurance arrangements. It is believed that Cunard Eagle and BKS have discussed a possible link-up, but no comment is available on this. Certainly the difficulties of other independents in recent months, particularly the Overseas affair, have made it difficult for even independents as reputable as BKS to obtain credit and to plan their financial futures with confidence.



AER LINGUS v. CUNARD EAGLE

FIRST foreign reaction to the ATLB's award of route licences to British United, Cunard Eagle and Starways (see page 900) comes from Ireland. Mr J. F. Dempsey, general manager of Aer Lingus, says:—

"The operations by Cunard Eagle Airways on the Dublin to Liverpool and London routes—Aer Lingus' most remunerative route—would have frightfully serious consequences to Irish Airlines. The relationship between two sovereign states in respect of traffic rights are reciprocal, so that airlines of each country could have 50 per cent of the traffic," Mr Dempsey said.

"The arrangement in 1956 envisaged a rising traffic, with 50 per cent opportunities for each state, but a third company coming into the route might call for a re-investigation of these arrangements.

"If, by any chance, US airlines succeed in getting into Dublin, the position by 1963 could show five lines operating on the Dublin - London route. Again, the over-competition would kill all companies, and there would be the situation you have in America itself, with mergers and take-overs."

Talks on the revision of the Irish-US bilateral agreement, held last month, have been adjourned without even the "full and frank exchange of views" communique being issued. Pan American and TWA are pressing for rights into Dublin and for permission to carry fifth freedom traffic to Britain and Europe. The present air agreement, in force for 15 years, allows the US carriers rights only at Shannon in which £12m has been invested by the Irish taxpayer.

MORE "TOP-OFF" PASSENGERS

ANOTHER all-freight operator is seeking permission to carry passengers at very low fares. Riddle Airlines of Miami, which last summer first asked the CAB to operate to New York and other north-east cities a no-frills air bus operation, is now proposing to operate Argosies and DC-7Fs on mixed passenger-cargo flights on a "no reservations" basis.

The proposed services would be between Miami and New York, Philadelphia, Washington and Boston. Orlando and Tampa would also be served. Argosies would be operated with 30 seats by day and 54 seats by night and DC-7Fs with 40 and 50 seats respectively. Fares, taking the Miami - New York sector, would be little more than £10 at night and less than £14 by day—considerably less than current fares, including those offered by surface carriers. Comparative surface rates (Miami - New York) are approximately £13 10s by bus, £15 10s by second-class train, £17 10s by propeller aircraft night coach, and £33 10s first-class by jet.

It is proposed by Riddle that baggage allowance be increased from 40lb (the present coach-class limit) to 100lb, with excess being carried at regular freight rates—which are about a third of the rates at present applied to excess baggage.

The services will be primarily freight operations with at least one-half of the payload available for cargo. Return passenger fares will be double one-way fares.

Structural test work on the Vickers VC10, the first of which is due to fly next year, is well ahead at Weybridge, and here a main wing torsion-box is seen being "slosh-sealed" to ensure integrity of the tanks

A Piaggio P.166, VH-CAC, is now being operated by the Australian Director of Civil Aviation. This view from the back of the roomy cabin shows well the good visibility enjoyed by the pilots

AIR COMMERCE...

LUFTHANSA BOEING TRAINING CRASH

A LUFTHANSA Boeing 720B, D-ABOK, crashed seven miles south of Mainz, West Germany, on December 4 while on a training flight, killing the crew of three. According to Lufthansa the aircraft was making an emergency landing. Eyewitnesses are reported to have said that the aircraft suddenly changed course, "flipped over on its starboard wing," and dived to the ground.

The 720B had taken off from Frankfurt International Airport. It was the fifth big jet to be lost in a crew training accident or on pre-delivery flight test; American Airlines has lost two Boeing 707-123s, Braniff a 707-227, and Delta a Convair 880. Crew-training accidents are not included in *Flight's* twice-yearly tables of accidents, which cover only revenue flights.

QANTAS IN 1960

IN September 1956 Qantas stole a march on its international rivals by ordering seven 138-series Boeing 707s, and securing delivery as early as the summer of 1959. As a result, QEA enjoyed a year of record business and precedented profitability. But by 1960, there was hardly anything but jets to be seen flying—mostly half-full—between Europe and Australia, and Qantas' profits came tumbling down. Needless to say, as the airline's report infers, it is all the other chap's fault.

Precise financial comparisons between the two years are difficult to compile, for Qantas moved the balance-date for their financial year from December 31 to March 31 to conform with the accounts of the two pool-partners, BOAC and Air-India. The accounts are, however, drawn up in such a way as to minimise the inconvenience caused by this change, and from this it can be seen that whereas Qantas capacity rose by 43 per cent, traffic rose by only 34 per cent, thus depressing load factors down to little over half-full. This poor result, combined with a reduction in revenue rates which resulted from the fast expansion which characterised the growth of low-rated categories of passenger, mail and freight traffic, could not even be countered by the dramatic fall in unit costs in which the Boeings were instrumental. For these reasons, the return on capital declined from about seven per cent in 1959 to about four per cent in 1960-61.

Except for the insidious spread of excessive capacity on to the Qantas network, no great changes affected the airline during the year. As a result of revised government policy, Qantas lost its New Guinea services, but was awarded new rights to fly to New Zealand in parallel with TEAL. The jet fleet remained unchanged at seven Boeings and four Electras, but the piston fleet was reduced to ten aircraft (eight Super-Constellations and two DC-4s) by the sale of three Super Constellations, one DC-4 and the New Guinea fleet of eight DC-3s and four Otters. The number of staff increased only slightly to 6,887, the recruitment of an additional 552 personnel to handle the increased level of business being largely offset by the transfer of 402 New Guinea staff to TAA.

Much as Qantas may have rued the events of 1960, the pattern looks like being repeated in the immediate few years, and no improvement in load factor can be seen for the current year 1961-62. As the newly appointed president of IATA, the airline's chairman, Sir Hudson Fysh, will no doubt use all his influence to persuade other members to do something about all those empty seats that are being flown around.

VISCOUNTS FOR CHINA?

FOR some weeks it has been reported (see *Flight*, October 26) that a Chinese order for Viscounts is likely. It is now said that a firm order—said to be for six aircraft with an option on perhaps six more—was signed in Pekin on December 1. No comment is forthcoming from the British Aircraft Corporation.

Although the Polish airline LOT acquired three Convair 240s from Sabena in 1957, this would be the first time that a Western manufacturer has received an order from a Communist airline. As a matter of history, the Chinese ordered a number of Vimy Commercials soon after World War I, although it is not certain whether these aircraft were actually built and delivered. The Board of Trade's ruling that Viscounts and the materials in them are not on the list of strategic exports which must not be sold to Communist countries is said to have finally clinched the deal in Vickers' favour. The US Government has "tried very hard" to stop the sale, according to Mr Jack Behrman, Assistant Secretary of Commerce, speaking in Washington on December 7.

The Civil Aviation Administration of China *alias* Minhaiduy, has hitherto relied exclusively on Russian equipment, and its present fleet—said to number about 120 aircraft—consists of Il-18s, Il-14s, Il-12s and Li-2s (Russian-built DC-3s).

The reported purchase of Viscounts by the Chinese has been described as "a resounding diplomatic slap at Soviet aircraft designers"; it would certainly represent an important breakthrough in East-West trading relations. To what extent a Viscount purchase may represent dissatisfaction with the Il-18 and to what extent it represents a need for replacing the Il-14s and Il-12s can only be conjectured at this stage.

BY 300 m.p.h. HOVERCAR TO PARIS?

HOVERCRAFT Development Ltd under Mr Christopher Cockerell has started design work on an all-British project, the Hovercar, which could carry 150 passengers from the Marble Arch to the Arc de Triomphe in 60 minutes. It would be capable of 300 m.p.h. Such a vehicle could obviously provide real competition for the airlines in time, even though it loses something in operational flexibility by having to make use of a special track.

Weighing 43 tons, the Hovercar would cost £150,000, or less than one-tenth of the first cost of a similar-capacity (150-seat) jet. The Hovercar is foreseen as a form of transport which could be widely used for high-speed travel between city centres, carrying large numbers of people over long distances quickly, comfortably and economically.

Operating on the same principle as the Hovercraft, the Hovercar has a suspension system and lift pads on its underside. The pads employ jets to generate and sustain the air cushions which support the vehicle. The Hovercar could also provide underground commuter transport at slower speeds, and with a greater passenger load than would be suitable for transport between city centres; this would also allow the cars to be linked together to form "hovertrains." Hovercars could be designed to cover a wide range of sizes and carrying capacity, up to large double-deck vehicles for several hundred passengers or an equivalent load of cars or freight.

A new variation on a now quite familiar theme is this motorized passenger stairway brought into use at Brussels by Sabena. Weighing about 2½ tons, the unit is powered by a 21 h.p. petrol engine and the steps can be adapted to any aircraft floor height of between 6ft 7in and 10ft 6in

Structural testing of the Boeing 727 is well under way and here a 19ft lower-surface wing panel is shown on test at Seattle. One complete airframe will be tested to destruction in a programme due to begin in November 1962; the fatigue test programme, involving another complete airframe, is due to end in April 1963 after proving a "life" of 20 years. The first 727 is due to fly in the autumn of 1962 and will be joined in the test programme by three others. Certification is due late in 1963

QUESTIONS IN THE HOUSE

SEVERAL important points emerged from answers given by Mr Thorneycroft to questions in the House of Commons on December 4. No production order had yet been placed by the Government for the Rotodyne but an order for the RAF is under consideration; a possible Service requirement for the de Havilland D.H.125 is under examination.

In reply to Mr Chetwynd, the Minister said he favoured the purchase of Vertol 107s by BEA for an inter-city helicopter service to be operated in co-operation with Sabena, and was discussing the terms proposed for this arrangement and BEA's future plans in relation to it before giving final approval to the purchase. Mr Chetwynd wanted it made clear that the use of American helicopters, even with British engines, was an interim measure and that we had to act quickly on this if we wanted inter-city helicopter services. Mr Thorneycroft said that it was just that kind of point which he was discussing.

In answer to Mr Emrys Hughes, Mr Woodhouse said that work on the development of Prestwick should be completed by the end of 1963; tenders were being invited for the provision of a large hotel. Asked about improving the facilities for passengers waiting to join jet flights between Prestwick and London, Mr Woodhouse said that the obstacles to a satisfactory solution have appeared insuperable, but promised to look at the problem again.

In reply to a question of Mr Strachey that foreign traffic rights should not be granted to British independents at the expense of BEA, Mr Thorneycroft said: "In all my negotiations with foreign governments my concern is to obtain the best possible deal for all British air transport operations."

The Minister replied in the negative to Mr Strauss's question of whether, in view of the change in the prospects of world civil aviation since the passing of the Civil Aviation Licensing Act, 1960, he would introduce amending legislation prohibiting the Air Transport Licensing Board from granting licences to applicants for permission to operate on routes already covered by BEA and BOAC. Mr Strauss also wanted BEA to be relieved of the payment of all fees normally chargeable in the airports under the Minister's control because of the losses that would result from independent competition, but again Mr Thorneycroft said "No, sir."

BREVITIES

MEA and Lufthansa have concluded a pool agreement covering services between Frankfurt and Beirut.

Riddle Airlines have now flown more than 12,200hr on Argosies, one of which has logged nearly 2,000hr.

At a petition before Mr Justice Buckley for the compulsory winding up of Air Safaris, it was stated that Esso were creditors for £103,000.

US airlines, in an attempt to beat the no-show problem, have agreed to charge passengers who book but do not fly $5 or 50 per cent of the ticket price, whichever is greater, with a maximum of $50. If the CAB approves, the plan will take effect on March 1.

Mr F. H. Wilson, chairman of Starways, is reported to have said of his company's hovercraft plans (*Flight*, July 20, page 104): "We wanted to carry ten vehicles and 100 passengers in a hovercraft and asked two British firms to make one for us. But neither can produce one of the size we would like."

New orders and repeat orders for Caravelles are the subject of unofficial reports: Varig, who have one in service, may order a further two or three: new orders are thought likely from Aer Lingus, TAP (three from June 1962), JAT of Jugoslavia, Austrian Airlines, and KLM.

It is reported that KLM is considering the possibility of rejoining Air Union. The airline participated in the initial planning talks three years ago, but withdrew at an early stage. The governments of the four national airlines concerned (Air France, Lufthansa, Alitalia and Sabena) are reported to have met in Brussels last week, with a view to inaugurating Air Union next April.

Mr Donald Walcott, head of the US company Trans Atlantic Airlines, of Gatwick, is moving to the Continent "because the Ministry of Aviation refuses to allow us office space at Gatwick." A Ministry spokesman said that no decision had yet been taken to renew the company's application for accommodation. In reply to this Mr Walcott said: "That's not what they told me." Last week the Ministry grounded one of the company's DC-4s because of unpaid landing fees.

As this issue went to press a decision by Malayan Airways on a DC-3 replacement was believed to be imminent. This company has been evaluating the Avro 748, Handley Page Herald and Fokker Friendship during recent months, and reports from Singapore suggest that the Dutch aircraft is favoured by this BOAC associate company. Malayan Airways is thought likely to have four Friendships.

It is expected as this issue appears that the CAB will have spoken on the US fares situation (*Flight*, November 16, page 780). Continental Airlines' proposal for jet economy domestic fares 25 per cent below coach class fares has been rejected by a three-two vote of the Board. Meanwhile Allegheny Airlines has been ordered to drop its no-reservations commuter flights between Philadelphia and Pittsburgh on the grounds that the fare is uneconomically low.

Cairo airport's new terminal building, on which the Egyptian Government has spent about £1m, will be opened on July 23, 1962.

As from December 1 Tu-114s operated the Moscow-Khabarovsk service at an increased frequency of five flights per week.

Dan-Air are planning to open a twice-weekly DC-3 service between Liverpool and Rotterdam next month, possibly on January 9. Newcastle, Cardiff and Bristol are included in the route.

An international airport costing £1m is to be built at Windhoek by the South-West African Administration. It will have a runway of 15,000ft.

According to Mr J. P. Hugo, general manager of South African Airways, SAA are not evaluating the Boeing 727 or the BAC One-Eleven. The Viscount, he said, "is the most successful aircraft SAA ever had and will continue in service for years yet."

The Civil Aeronautics Board has given US airlines permission to discusss the pooling of facilities and equipment to help reduce costs. The CAB has refused, however, to allow the pooling of aircraft, revenues or traffic, as this would constitute an infringement of anti-trust laws.

An application to the ATLB by Air Links for inclusive-tour services with Villa Parties, a British travel agent, from Gatwick to Geneva has been withdrawn. The reason given is that the agent finds that he can get these flights carried out by a foreign operator.

With effect from April 1, 1962, all international flights to Stockholm will use Arlanda airport, which will also be open to domestic traffic. Bromma will be open to domestic traffic only, and will only be used for international flights when diversions from Arlanda are necessary.

According to Mr A. H. Milward, chief executive of BEA, an unofficial stoppage of instrument electricians "makes it still more certain that BEA will finish in the red this year." The recent loaders' strike cost BEA £300,000, and Mr Milward considers that the present dispute is "deplorable" and "totally improper."

The possibility of an Air Traffic Control Association was discussed at a meeting in London recently of 67 air traffic control officers representing 44 air traffic control units in the UK. The proposed aim is the advancement and improvement of air traffic control with regard to proficiency and conditions of service. On August 15, 1962, the mandatory ATCO's licence will become effective.

More details are available of the Lufthansa Mach 3 supersonic airliner project of which an illustration appeared in *Flight* for October 19, page 644. The aircraft has four by-pass engines of 39,700lb thrust each for take-off. Accommodation is quoted as 140, and "range" as 4,225 miles at an altitude of 65,000-75,000ft. Take-off field length is 8,860ft and landing field length 8,200ft. Length is 203ft, span 98ft and height 48ft. Takeoff weight is 396,830lb and maximum landing weight is 242,510lb. Payload is quoted as 32,520lb.

Missiles and Spaceflight

LORDS DEBATE SPACE

Speaking in a three-and-a-half-hour debate on space research in the House of Lords on December 6, the Earl of Bessborough announced that he and Mr G. K. C. Pardoe had been invited by the head of the Soviet Academy of Sciences "to visit the Soviet Union to meet their own space scientists." Lord Bessborough is connected with Pye and ATV, two of the member companies of the British Space Development Company; and Mr Pardoe is chairman of the BSDC technical committee and chief engineer (weapons and space research) of de Havilland Aircraft.

Although the debate included discussion on the scientific and military potentialities of space, its main theme was that of communication satellites. On this, Lord Bessborough suggested that private enterprise might raise a proportion of the funds required: "I feel that if the British Space Development Company were authorized to raise money by public subscription there might be hundreds of thousands of people in this country who would be inclined to risk a moderate investment on the basis of the calculated profitability of a communications satellite. I do not feel that the burden should lie solely on the taxpayers . . ."

SATELLITE FOR AMATEURS

A 10lb communication satellite designed and built by a group of California radio amateurs was due to be launched in a piggy-back firing aboard the USAF Discover 36 satellite from Vandenberg AFB, California on December 12.

A spokesman for the radio amateurs said that the satellite would radiate a constant signal in the 2-metre worldwide amateur radio band, as a "serious, civilian, non-commercial effort to introduce radio amateurs and lay scientists to new concepts in outer-space communications." Known by its designers as Oscar, the satellite will transmit the letters HI in Morse code on a frequency of 145 Mc/s. Oscar means "orbital satellite carrying amateur radio."

MISSING SATELLITE

A minor mystery, but one which could be significant for the future of international space science, has been caused by the omission of the USAF satellite launched from Point Arguello on November 22 from the list of satellites, with internationally agreed designations, published by the US National Aeronautics and Space Administration. Ranger 2, launched on November 18, is designated 1961 Alpha Theta, and the next consecutive name, 1961 Alpha Iota, is bestowed upon the Mercury MA-5 launched on November 29.

Apart from stating that the November 22 launch was successful, that it was by Atlas Agena B vehicle, and that the satellite was carrying "a number of classified test components," the USAF gave no details of the Point Arguello firing, which was unofficially believed to have involved one of the Samos series of experimental reconnaissance satellites. At the time of going to press it was uncertain whether the November 22 launch was in fact unsuccessful, or whether a falsification of international records of space activity was being attempted.

AS.30 VERSUS BULLPUP

For nearly a year the Nord AS.30 and Martin Bullpup have fought for adoption as the standard NATO tactical air-to-surface missile. Last week the *Guardian* newspaper reported that the Royal Air Force had "decided to order" the French weapon; and, although this has not yet been officially confirmed, there is no doubt that it is this missile that the RAF would like to buy. Although selection of AS.30 by the RAF would not automatically mean its adoption by NATO, it would undoubtedly be an important factor in its favour. Previously AS.30 had been bought by the French Air Force for use from Mirage III and Vautour aircraft.

Both missiles were described in our special review dated November 2. AS.30 is a natural development from the Nord AS.20, a full description and cutaway drawing of which appeared in *Flight* for July 15, 1960. Like the earlier missile, it has radio command guidance effected by the pilot of the launch aircraft, who uses a miniature control column to fly the missile visually into the target. AS.30 is 149.5in long, has a cruciform of acute-delta wings of 39.4in span, a body diameter of 13.8in, weighs 1,000lb and carries a 505lb warhead. No nuclear warhead has yet been designed for it. Bullpup is now a family of missiles, all characterized by radio command guidance (in later models making provision for offset control, in which the pilot, missile and target need not be visually aligned), rear fixed wings and forward control surfaces. Bullpup B for the US Navy and GAM-83B for the US Air Force can carry nuclear warheads.

Principal carrier aircraft in NATO service would be the F-104G although the F-100, F-84F, Hunter and other types (not including the G.91) might be involved. RAF carriers include the attack versions of the Canberra, and possibly the Hunter or even a helicopter. The Royal Navy also has a requirement for such a missile for use by Buccaneer, Scimitar and possibly Sea Vixen squadrons; and it is no secret that their choice has been Bullpup. It is impossible to say to what extent the Fleet Air Arm is reconciled to the Nord missile (on September 7 we repeated an unofficial report that they were quite happy with it), but there do not appear to be any technical objections. One of the key factors in assessing compatibility with the F-104G has been ground clearance, which is no problem with the British aircraft involved. Total NATO requirement for a weapon in this class exceeds 10,000 rounds, and the RAF/RN order will probably be for about one-fifth as many. Unit price of AS.30 with h.e. warhead, is variously reported as £2,000 and £3,000; Bullpup is certainly cheaper than the latter figure.

SEASLUG TRIALS COMPLETED

On December 5 HMS *Girdle Ness*, the Royal Navy trials ship, was paid off at Devonport after completing the acceptance trials of the "medium-range" ship-to-air guided weapon Seaslug Mk 1. These trials were outstandingly successful, and the complete weapon system is now cleared for service with the Fleet. The Admiralty state:—

"In the recent series of firings, 90 per cent of missiles intercepted the target, and, had live warheads been fitted, the target would undoubtedly have been destroyed. The most outstanding aspect of this missile is its degree of reliability, which is unmatched by any other missile in the world today. Seaslug has been subjected to the most rigorous environmental tests including extremes of temperature, damp and vibration. It has been transported by sea and air to Malta, and has been fired by HMS *Girdle Ness* at a wide variety of targets. In the final series of trials, radio-controlled Canberra aircraft at great heights have been used as targets, and on no occasion did the missile fail to intercept. Other successful firings have taken place at aircraft flying low over the surface of the sea. It can be stated with confidence, therefore, that when it is embarked next year in the County-class guided weapon destroyers, Seaslug will be the best ship-borne surface-to-air missile at sea in the Western world."

Capt Peter Lachlan, RN, who commanded *Girdle Ness* during the acceptance trials, stated that more than 200 rounds had been fired. The successful interception figure of 90 per cent—reported above—would have been approximately 99 per cent if all missiles had been fired in pairs (as they presumably will be in all operational installations). Moreover, he confidently believed that the figure would have been 100 per cent, were it not for the fact that during acceptance trials many shots are against almost impossible targets, in order to determine the limitations of the system. He commented on the experience gained in shipboard maintenance and personnel training, and paid tribute to the excellent co-operation between RN personnel, members of the RN Scientific Service and civilians from industry. Leading firms included Whitworth Gloster Aircraft, GEC, Sperry and EMI, and ship's guidance radar (Seaslug is a beam-rider) was developed at the Admiralty Surface Weapons Establishment at Portsdown. First ship to use the missile operationally will be *Devonshire*, now nearing completion.

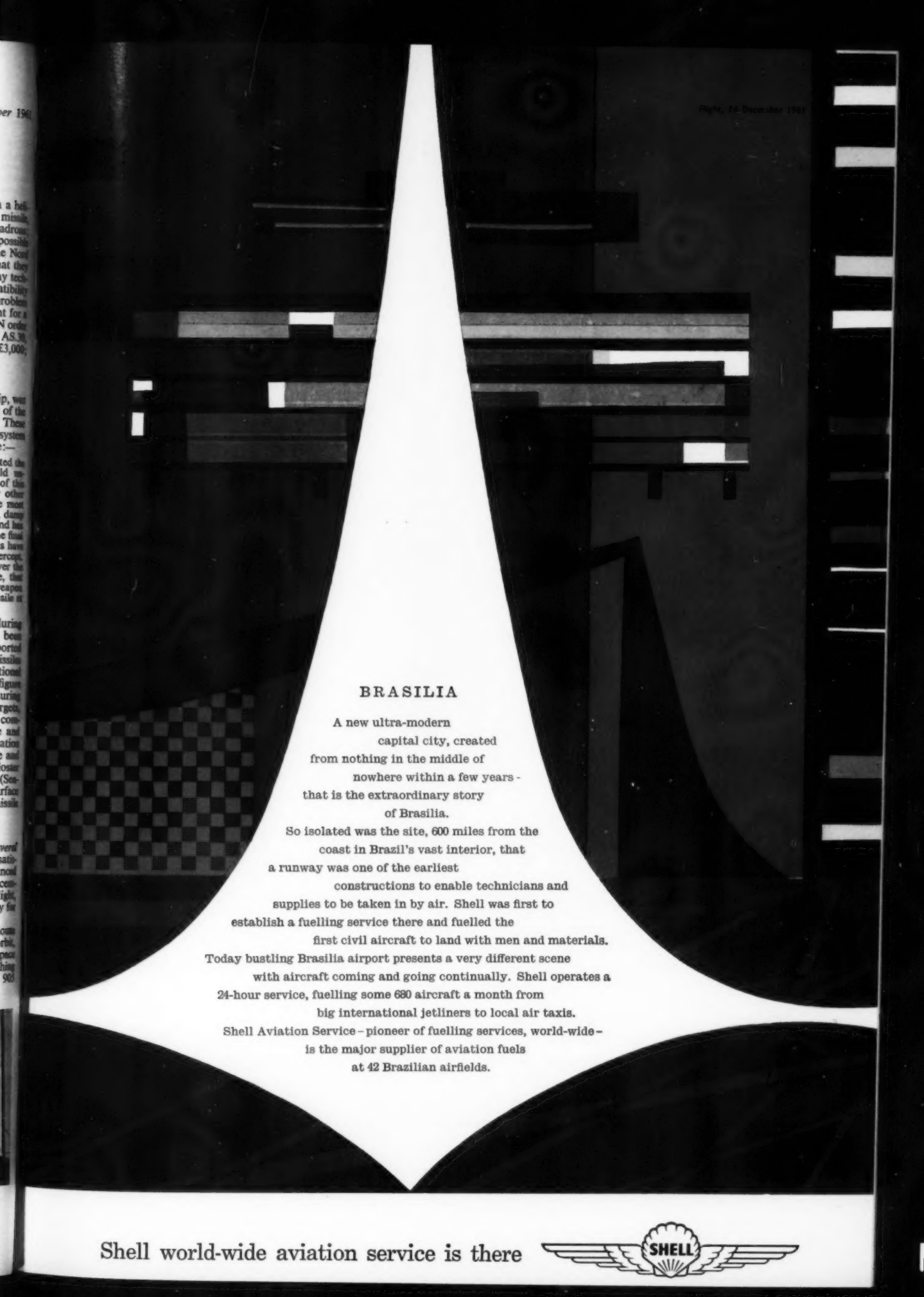
US PREPARES FOR MANNED ORBIT

Cape Canaveral

"Final preparations for Mercury-Atlas 6 are progressing satisfactorily for a launch attempt early next year," it was announced by the National Aeronautics and Space Administration on December 6. Based on a preliminary analysis of the MA-5 orbital flight, NASA had decided that the Mercury-Atlas system was ready for manned orbital flight.

With American prestige on the line in this shot, the White House had been letting NASA's Mercury team shoot for a 1961 orbit, but President Kennedy's advisers had clearly warned the space administration to watch out for high-level repercussions if anything went wrong through undue haste. [*Continued on page 905*]

Mercury astronaut John H. Glenn Jr (right) has been chosen as the pilot for the first US manned orbital flight, which is scheduled for next month. Reserve pilot for the flight is M. Scott Carpenter



BRASILIA

A new ultra-modern capital city, created from nothing in the middle of nowhere within a few years - that is the extraordinary story of Brasilia.

So isolated was the site, 600 miles from the coast in Brazil's vast interior, that a runway was one of the earliest constructions to enable technicians and supplies to be taken in by air. Shell was first to establish a fuelling service there and fuelled the first civil aircraft to land with men and materials.

Today bustling Brasilia airport presents a very different scene with aircraft coming and going continually. Shell operates a 24-hour service, fuelling some 680 aircraft a month from big international jetliners to local air taxis.

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Missiles and Spaceflight . . .

Lt-Col John Herschel Glenn, Jr, 40-year-old Marine test pilot, has been named primary choice for the first orbital mission. Navy Lt-Cdr Malcolm Scott Carpenter, 36, is secondary choice. Their selection—an open secret for a fortnight—was made official by an announcement at a news conference here.

Maj Donald K. Slayton, USAF, and Cdr Walter M. Schirra, Jr, USN, were designated primary and backup pilot for the second flight, which probably will come about March 1962. Neither of the two sub-orbital spacemen, Cdr Alan B. Shepard and Capt Virgil I. Grissom, is currently scheduled for an orbital mission.

As reported in last week's issue, the launch of Mercury-Atlas 5 took place on November 29. The capsule carried a 38lb chimpanzee (*Pan troglodytes*) named Enos into what was to have been a three-orbit, 4½-hr flight. At the end of two orbits the capsule was commanded to re-enter prematurely because of capsule overheating and a malfunction in the fine control of the spacecraft's attitude.

Despite the premature termination of the exercise, officials in charge of Project Mercury termed it successful and said that plans for a manned orbital flight would not be adversely affected. A human occupant of the spacecraft could have corrected the heating trouble and overridden the automatic mechanism controlling the attitude rockets.

The November 29 flight was a fullscale dress-rehearsal of all Project Mercury's elements. According to Mercury officials' statements after the mission was over, everything went well except for the two malfunctions—which, they emphasized repeatedly, could have been fixed on board.

The capsule's orbit was defined as 99 miles perigee, 146 miles apogee, period 88 min, inclination to equator, 32 deg. The chimpanzee Enos survived the trip well and performed psychomotor tasks with apparent efficiency and dispatch.

The animal and capsule, rescued from the sea 250 miles south of Bermuda at 2.53 p.m. (EST), were later brought to Cape Canaveral for further examination. Detailed information on the chimp's reactions to weightlessness, high g and other factors were expected to take about ten days to distill from the welter of tape-recorded telemetry taken during the flight.

Even before the chimpanzee and his spacecraft were returned here, crews were busy with preparations for the forthcoming manned launching. Pad 14, only launching facility for Project Mercury, was expected to be ready to receive another Atlas within a day or so. The Atlas, numbered 109D, was flown from San Diego aboard a C-133 Cargomaster, arriving at Patrick Air Force Base on the same day as the chimpanzee's flight. WILLIAM HINES

SPACE LAW DEFINED

One of the dangers confronting space law flows from its being indulged in as a form of escapism, according to Dr Bin Cheng, Lecturer in International Law and Air Law at University College, London. Addressing the British Interplanetary Society on December 2 in a lecture entitled "The Extra-Terrestrial Scope of International Law," Dr Cheng submitted that some people spoke of outer space as if it were a new Shangri-La where man, once there, would immediately shed his earthly qualities of selfishness, greed for power and all the other evils that came out of Pandora's box. The irony was, he suggested, that these people, in busily planning new worlds for old, actually fostered (albeit unintentionally) the fallacious impression that outer space was at present in a state of complete lawlessness.

In "a determined effort to rid the subject of some of its slippery glossiness," the lecturer, speaking primarily of international law, treated the conquest of space as merely another step in the continual expansion of the geographical frontiers of this legal system. By means of the accompanying chart, Dr Cheng showed how international law had already followed man's footsteps into outer space.

The lecturer first explained that the geographical scope of international law was essentially the same as that of State jurisdiction. He next divided State jurisdiction into three types: territorial, quasi-territorial and personal. Finally, by separating each type of State jurisdiction into its legislative (jurisfaction) and its enforcement (jurisaction) aspects—a distinction which he has introduced into the legal vocabulary—Dr Cheng arrived at the conclusion that all types and forms of State jurisdiction already extended to human activities in outer space—except territorial jurisaction which the lecturer, opposing a widely held view, regarded as also capable of being so extended. In other words, international law was even now fully applicable extra-terrestrially, even though there might be many problems for which new rules might have to be established.

STATE JURISDICTION

Type	Territorial		Quasi-territorial		Personal	
Object	*Terra firma* (terrestrial or extra-terrestrial) including adjacent maritime belt, subsoil and superjacent space		Ships, aircraft and spacecraft		Individuals, corporate bodies and business enterprises	
Material Scope	In respect of the whole territory, including all its resources, all persons and things therein, and the extra-territorial activities of all such persons, whether individual or corporate		In respect of the craft themselves and all persons and things therein, including the activities of such persons, individuals or corporate, whether on board the craft or elsewhere		In respect of individuals, corporate bodies and business enterprises, and all property, rights and legal interests belonging to them, wherever they may be	
Source	*International customary law:* sovereignty, law of war and *status mixtus*, including self-defence and reprisals *Treaties* with, and *recognition* or *acquiescence* of, other international persons, e.g. protectorates, leased territories, mandated and trust territories		*International customary law:* State jurisdiction over flag-craft (right to confer flag may be derived from nationality of owner or charterer, other "genuine links," registration, and the *consent, recognition* or *acquiescence* of other international persons)		*International customary law:* State jurisdiction over nationals, including corporate bodies and business enterprises endowed with nationality, other persons owing allegiance, and pirates *jure gentium* *Treaties* with, and *recognition or acquiescence* of, other international persons, e.g. protected persons	
Form	**Jurisfaction**	**Jurisaction**	**Jurisfaction**	**Jurisaction**	**Jurisfaction**	**Jurisaction**
Heirarchy / Precedence	On a par with other types of jurisfaction	First In case of conflict, overrides quasi-territorial and personal jurisaction	On a par with other types of jurisfaction	Second In case of conflict, gives way to territorial jurisaction but overrides personal jurisaction	On a par with other types of jurisfaction	Third In case of conflict, gives way to both territorial and quasi-territorial jurisaction
Geographical Scope	Limitless (terrestrial and extra-terrestrial)	National territory of a State, other territory for the international relations of which it is responsible and territory under its *occupatio pacifica or bellica*	Limitless (terrestrial and extra-terrestrial)	Over flag-craft anywhere outside territories subject to the territorial jurisaction of other recognized international persons	Limitless (terrestrial and extra-terrestrial)	Over all individuals, corporate bodies and business enterprises subject to a State's personal jurisdiction outside territories or craft subject to the territorial or quasi-territorial jurisaction of other recognized international persons
Relevance to space law	Extra - terrestrially applicable	Stresses the urgent need of clearly delimiting national space from outer space. Will also apply to extra-terrestrial territories, once sovereignty established and recognized in accordance with existing rules of international law	Extra - terrestrially applicable	Extends to national spacecraft in outer space	Extra-terrestrially applicable	Extends to nationals and other persons or entities subject to a State's personal jurisdiction even when they are in outer space

Diagram © Bin Cheng 1961

Missiles and Spaceflight . . .

AMERICA'S AIMS IN SPACE

2. The Launch Vehicles and their Operation

By KENNETH OWEN

America's heavy workhorse for space will be Saturn. The eight-engined first stage (below right) was fitted with dummy upper stages for a successful first flight on October 27. Below, the Saturn blockhouse at Cape Canaveral

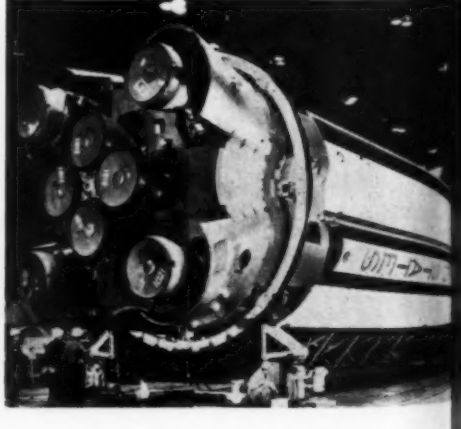
OVERSHADOWING all else on the United States spaceflight scene is Project Apollo, the accelerated manned lunar programme called for as a major national goal by President Kennedy on May 25 last. The President said, "No single space project will be more exciting or more impressive, or more important for the long-range exploration of space; none will be so difficult or expensive to accomplish." Within six months, the National Aeronautics and Space Administration had selected Massachusetts Institute of Technology as associate contractor for Apollo guidance and control, and were negotiating with North American a $400m prime contract for two of the three main sections of the actual spacecraft.

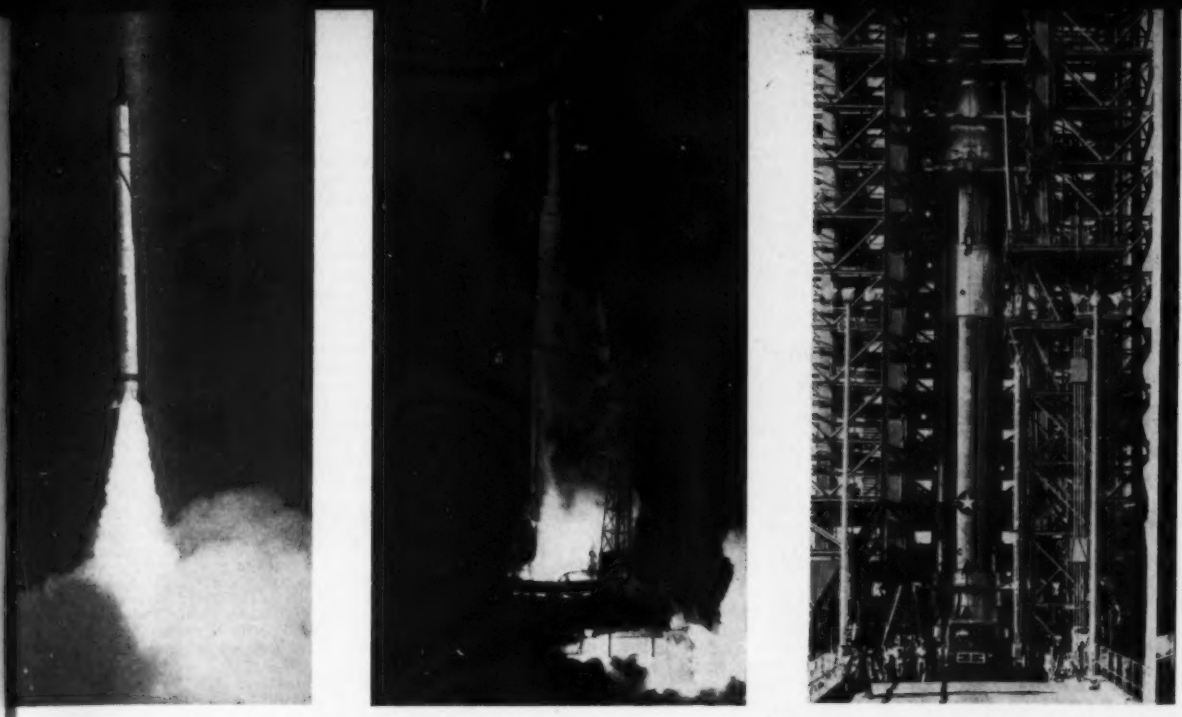
Most of the difficulty and expense referred to by President Kennedy in connection with Apollo will arise in the development of the launch vehicles needed to transport the three-man spacecraft to the Moon and back to Earth. Not that this is confined to Apollo, for vehicle development is an obvious key factor in accomplishing *all* the space missions on which, as described in last week's issue, NASA is currently engaged.

The environment in which these launch-vehicle systems are being developed was described at the recent American Rocket Society meeting in New York by Mr Willis M. Hawkins, vice-president and general manager of Lockheed Missiles and Space Company, who listed four main points of overall design philosophy.

First, Mr Hawkins commented, "What we are doing now is just barely possible and just barely reliable. And on this basis, we are making highly ambitious plans." Secondly, it was true that dollars were available—but only one year at a time. Thirdly, the USA did not possess the initiative in space; and finally, a new and better idea was often discovered halfway through a project, i.e., one had to face change.

Among the tasks ahead, Mr Hawkins listed three in particular: (1) reliability must be improved, (2) costs must be matched to the budget by using the "building block" principle, and (3) changes should be recognized as being desirable and honourable. There





These three vehicles have important roles in the US space programme: from the left, the four-stage, all-solid Scout; the three-stage Delta (with Thor as first stage); and the two-stage Centaur (Atlas first stage) now being developed

were in fact three areas of reliability, termed by Mr Hawkins get-back reliability (a multi-engined safety standard should be aimed at), long-life reliability (the fewer the components the longer the life), and stay-sane reliability (it would be much simpler if men could hibernate during journeys to the Moon or Mars). Failure rates could be reduced and reliability improved, he concluded, by attention to simplifying system design.

For long-range manned missions, nuclear rocket engines have more potential than the liquid and solid chemical systems, and in particular have a greater potential specific impulse. To obtain this specific impulse, the basic problem is one of materials capable of operating at the required high temperatures.

Project Rover, under which nuclear rocket engines are being developed, is directed by the joint NASA/AEC Space Nuclear Propulsion Office established last year. It should result in an operational nuclear rocket engine, i.e., one capable of carrying out an actual manned mission in space, "within about a decade," according to Dr Glen T. Seaborg, chairman of the US Atomic Energy Commission, with test flights in 1965-67. Although Dr Seaborg has expressed his opinion that the space funds budgeted for nuclear propulsion are adequate, this view was obviously not shared by Mr R. W. Bussard of the Nuclear Propulsion Division of Los Alamos Scientific Laboratory, who maintained vigorously at the ARS meeting that the US was not nearly as diligent as she might be in this new field.

Mr Krafft Ehricke, Centaur programme director for General Dynamics/Astronautics, joined Mr Bussard in urging an accelerated nuclear-propulsion programme. Both maintained that the budget for this should be increased: Mr Bussard suggested that more money could perhaps be justified if the military use of space were reconsidered; if, however, the total for space remained fixed and some other programme had to cut to provide more funds for the nuclear work, he would suggest reducing the amount of pure scientific research in space carried out by unmanned vehicles.

Two other ARS speakers had important comments to make on other aspects of vehicle development. Mr Kurt H. Debus, director of NASA's Launch Operations Directorate at Huntsville and Cape Canaveral, spoke on launch operations; and Mr Norris F. Dow of General Electric's Space Sciences Laboratory, on special vehicle problems. Mr Dow discussed the radiation hazard in manned space flights (if 20,000 volts/cm could be generated in space, shielding weight could be reduced markedly), the re-entry problem (the paraglider or 'Rogallo wing concept should be considered as a re-entry aid); and the rendezvous problem (rendezvous could be made, not only in Earth orbit, but also "at the other end," i.e., in lunar orbit, using ferry vehicles).

On the subject of launch operations, Mr Debus claimed that a "quantum jump" was necessary to meet the challenge of the lunar programme. "The present launch-system concept is a victim of the evolution which created it," he said; "Now we have reached the end of evolution, culminating in Complex 34" [the Saturn pad at Cape Canaveral, described in *Flight* of November 9, 1961]. The heavy service gantries and reinforced blockhouses were typical of the massive facilities which had evolved.

The purpose of the servicing tower was for assembly and preparation of the vehicle (and for protection against hurricanes, which made it very expensive); the tower was necessary because assembly-building tests were not considered valid when the vehicle was subsequently moved to the launch-pad. As for the blockhouse, this was separated from the vehicle by a minimum distance because of the required transfer of intelligence. Ground support equipment had to be as close as possible, hence all the reinforced concrete.

A preparation time of approximately two months, plus one month to re-prepare the pad after each successful firing, was typical for a Saturn-class vehicle in this type of launch complex—i.e., the limit was four equally spaced shots per year. The complex represented an investment of some $45m, plus real estate.

Mr Debus went on to describe a possible Saturn C-3 complex, which contained neither service tower nor blockhouse. A fixed, four-bay vertical-assembly building would be employed, with the launch vehicle and umbilical tower mounted on rails or on a barge. After the vehicle had been checked out in the assembly bay, it would be moved on rails to an arming tower, where escape rockets would be fitted. Then by rail again a distance of, say, 10,000 ft to one of about five launch pads. For solid-propellant vehicles, a second assembly building could be used in order to double the launch rate. The same equipment would be used for both checkout and launch, so that a blockhouse would not be needed.

Although such an installation would cost an estimated $190m compared with the $45m for Complex 34, it would permit a much higher rate of launching. To obtain a comparable rate of 32 shots per year, one would need eight conventional pads, amounting to $360m plus real estate—and a larger area would be covered. For Saturn C-3 and C-4 vehicles, Mr Debus suggested the new scheme described above.

Costs and Vehicles Before continuing from the above general comments to details of specific vehicles, it is interesting to note the expenditures involved in four of the major programmes—Saturn, Rover, the F-1 engine and solid propellants. NASA's estimated costs up to and including the budget for the current 1962 fiscal year (July 1, 1961 to June 30, 1962) are: Saturn, $558m; Rover, $58.1m; F-1 engine, $160.2m and solid propellants, $6.8m. When Defense Department and Atomic Energy Commission figures are added, the overall totals are Saturn, $659.3m, Rover $241.2m, F-1 engine $161m and solid propellants $68.8m.

NASA's development of the F-1 1.5m lb thrust liquid-propellant engine for use in Nova is being augmented by a parallel Defense Department programme leading to large solid boosters. The current tentative plan is for a segmented solid-propellant motor weighing some 375 tons and providing 2-3m lb thrust for 60sec, which could be clustered as required to give the desired total first-stage thrust, and used if necessary also in the second stage. [*Continued overleaf*

Rocketdyne picture and model of nuclear rocket engine based on solid-core reactor (central cylinder). Such engines are under study for future use in the upper stages of Saturn vehicles

AMERICA'S AIMS IN SPACE...

The broad US philosophy is that it would be unwise to become committed at this time to either the liquid or the solid booster for Nova. The decision on which to choose will be made at a later stage—when static testing of both types has been carried out—after a realistic assessment of the relative availability, reliability and economy. At present the country is carrying an expensive but presumably necessary form of insurance.

In the paper "Development Report on Saturn" presented at the ARS meeting, Mr Konrad K. Dannenberg of NASA's Marshall Space Center included the following review:—

"During the early reports of this year the Saturn C-1 programme became identified with the primary objective to inject unmanned and manned Apollo spacecraft into Earth orbits. This departs from earlier plans to fly essentially lunar or deep-space missions, which require multi-stage boosters for high cut-off velocities, with smaller payloads (up to 5,000lb). The new Apollo programme emphasizes trajectories into low orbits with rather heavy payloads. This phase of the Apollo programme aims to provide development information on all Apollo subsystems, particularly the heat protection. Therefore the orbital missions will be complemented by a few re-entry tests under simulated parabolic velocity conditions. The planned flights will also establish the compatibility of the Saturn launch vehicles and the Apollo spacecraft.

"Optimization studies conducted for the new requirements as well as reliability and cost considerations led to a Saturn C-1 configuration with two stages only. . . . A thorough analysis led to the decision to fly the first few live booster vehicles without modifying the former [three-stage] configuration. This decision was essentially based on the availability date for the 15,000lb hydrogen engines, which determines the earliest possible test date for live hydrogen upper stages; furthermore, this decision also considered the long-range plan to add eventually a third stage for planned deep space missions . . .

"This de-emphasis of a third stage permits the development of the flight Saturn in two major steps, identified by Block 1 and Block 2. Early flight data will be obtained from the launch of a Saturn Block 1 vehicle. The decision not to redesign the dummy-carrying version enabled the Marshall Center to concentrate the engineering team on the modifications of the final Block 2 version with live upper stages. Results of component and structural tests as well as static firings have accumulated engineering data which show that a number of design changes are most desirable. . . . The majority of the improvements will be introduced with the Block 2 configuration, which now will incorporate the following features:—

(1) The new booster stage will utilize the uprated (to 188,000lb) H-1 engine with various improvements.
(2) The S-1 will get an increased propellant capacity of 850,000lb compared with 750,000lb in Block 1 boosters.
(3) The Block 2 booster will be equipped with detachable fins.
(4) The second S-4 stage will use six Pratt & Whitney RL-10A-3 hydrogen engines rather than four LR-119 engines as originally planned.
(5) Booster recovery has been delayed. Earlier plans to recover the S-1 booster stage by drag chutes and water-entry methods were postponed due to increasing awareness of recovery problems as well as recovery-influenced booster problems . . . "

Dr Wernher von Braun commented further on the various types of Saturn (listed below) at a Press conference in New York. For the manned lunar landing mission, he said, the choice was between, the Nova vehicle and Saturn C-3 or C-4. The Saturn vehicles would need to employ orbital rendezvous operations (involving four C-3 vehicles or two C-4s), while Nova would not. It was unlikely that both the C-3 *and* C-4 versions of Saturn would be built, and the choice would be between Saturn C-3 plus Nova, and Saturn C-4 alone (since the performance of Nova was markedly better than the C-3, but not so much better than the C-4)

Dr von Braun and NASA Administrator James E. Webb both emphasized that orbital rendezvous would be developed in any case as a general spaceflight technique, whether or not it was employed to accomplish Project Apollo. The best "route to the Moon" for Apollo is currently being investigated by a joint team from NASA, the USAF and Aerospace Corporation.

Main details of the five launch vehicles on which NASA's major present and future programmes are based are given below. Not included are a number of familiar vehicles such as Atlas Agena, Thor Agena and Thor AbleStar, which have proved their ability to launch satellites but which (except for Thor Agena in the veteran Discoverer series) may be regarded as interim vehicles. Also omitted here are Project Mercury's Redstone and Atlas boosters. Figures quoted in lb refer to engine thrust.

Scout Intended as a reliable, relatively inexpensive vehicle for general space research, including orbital, probe and re-entry missions, Scout is the smallest of the basic NASA family of launch vehicles, and the first US all-solid rocket to place a satellite in orbit. In current use; later version to fly mid-1962 (prime contractor Vought Astronautics).

Stages: (1) 115,000lb Algol (Aerojet); (2) 50,000lb Castor (Thiokol); (3) 13,600lb Antares (ABL); (4) 3,000lb Altair (ABL).

Capable of placing 150lb in 300-mile orbit or carrying 50lb to 8,500 miles. Successful Scout launches have included Explorer 9 and Explorer 13 satellites.

Delta Designed as a reliable space vehicle to replace the Thor Able, Juno 2, Jupiter C and Vanguard vehicles for launching medium-payload satellites and small-payload space probes. In current use (prime contractor Douglas).

Stages: (1) Modified Thor (150,000lb Rocketdyne MB3-1, or 170,000lb MB3-2 in later versions); (2) Aerojet AJ-10-118; (3) ABL X248-A5 solid.

Capable of placing 500lb in 300-mile orbit (500-mile orbit with later versions). Satellite payloads launched by Delta have included Echo 1, Tiros 2, Tiros 3, Explorer 10 and Explorer 12.

Centaur Under development as a general-purpose, high-performance launch-vehicle for Earth satellite, lunar and planetary exploration missions, and in particular for synchronous-satellite orbits at 22,300 miles and deep space probes. Capable of placing 8,500lb into a 300 n.m. Earth orbit, or 2,500lb into a lunar-probe trajectory. First flight 1962; first operational vehicle late 1963 (prime contractor General Dynamics).

Stages: (1) Modified Atlas (total thrust 360,000lb); (2) two 15,000lb P & W RL-10A liquid hydrogen/liquid oxygen engines.

Technical difficulties in the RL-10A engine development programme have delayed the availability of flight engines by approximately six months, forcing a change to Atlas Agena for a reduced-payload Mariner launch next spring and possibly delaying the Advent synchronous communication-satellite programme.

The high-energy RL-10A engines used for the first time in Centaur will also be used in the upper stages of the Saturn and Nova vehicles. Centaur has been described by Mr Milton W. Rosen, Director of Launch Vehicles and Propulsion in NASA's Office of Manned Space Flight, as "To my mind, the most difficult vehicle project the US has ever attempted; in some ways more difficult than Saturn." It has also been stated officially that the RL-10A engines might be adapted for use as an upper stage for Titan 2 as a space launcher.

Saturn Under highest-priority (DX) development as a multi-purpose vehicle system using a "building-block" approach for the upper stages to achieve a variety of configurations, the Saturn family of vehicles is intended to meet future space requirements for large payloads. First flight (first stage plus inert upper stages) October 27, 1961; first operational flight late 1964.

Saturn C-1. Stages: (1) eight 188,000lb Rocketdyne H-1 engines (S-1 stage); (2) six 15,000lb P & W RL-10 engines (S-4 stage). Capable of placing 20,000lb in near-Earth orbit.

Saturn C-2. Stages: (1) eight H-1 engines (S-1A stage); (2) four 200,000lb Rocketdyne J-2 engines (S-2 stage); (3) six RL-10 engines (S-4 stage). Capable of placing 45,000lb in near-Earth orbit; 15,000lb to escape velocity.

Saturn C-3. Stages: (1) two 1.5m lb Rocketdyne F-1 engines (S-1B stage); (2) four J-2 engines (S-2 stage); (3) six RL-10 engines (S-4 stage). Capable of placing 80,000-100,000lb in near-Earth orbit; 30,000lb to escape velocity.

Saturn C-4. Stages: (1) four F-1 engines; (2) four J-2 engines; (3) six RL-10 engines. Capable of placing 200,000lb in near-Earth orbit.

Saturn C-5. Stages: (1) five F-1 engines; (2) four J-2 engines; (3) six RL-10 engines. Capable of placing 250,000-300,000lb in near-Earth orbit.

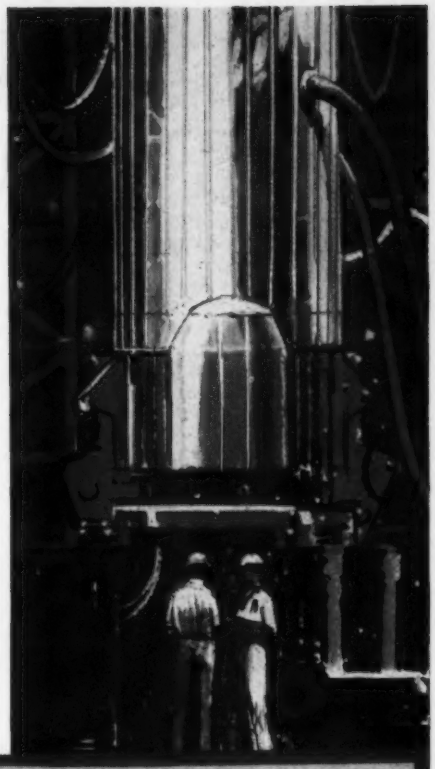
Nova Under study in several versions for possible direct lunar flight (with payload including propulsion system for return flight from Moon to Earth) as alternative to Saturn C-3 and/or C-4 using rendezvous techniques. Anticipated first flight 1966.

All-liquid Nova. Stages: (1) eight 1.5m lb Rocketdyne F-1 engines (LN-1 stage); (2) two Rocketdyne F-1 engines (LN-2 stage); (3) four 200,000lb Rocketdyne J-2 engines (LN-3 stage); (4) six 15,000lb P & W RL-10 engines (LN-4 stage); (5) two P & W RL-10 engines.

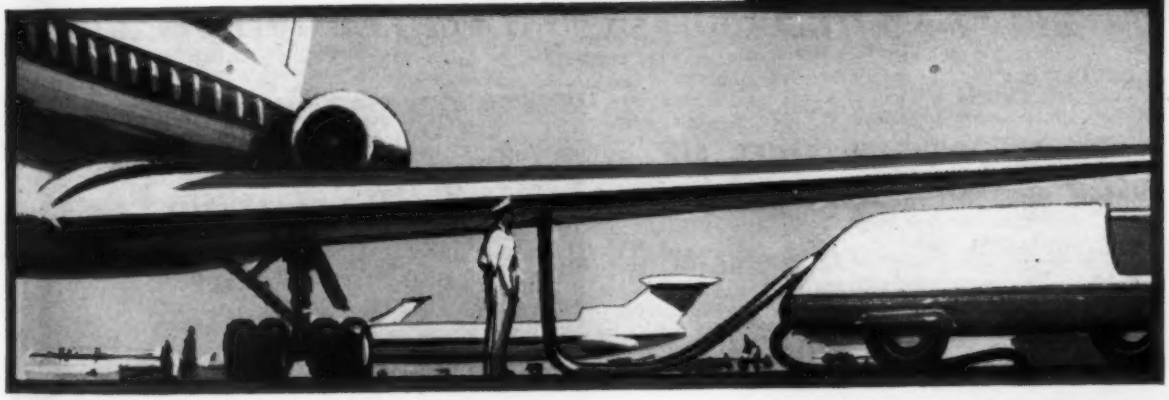
Solid/Liquid Nova. Stages: (1) solid-propellant stage; (2) solid-propellant stage; (3) four J-2 engines; (4) six RL-10 engines.

The Nova vehicle would be capable of placing approximately 25 tons on the surface of the Moon, corresponding to an "escape capability" of approximately 50-75 tons.

(*To be concluded*)



Down go fuelling costs with the new A.W.E. fuel coupling



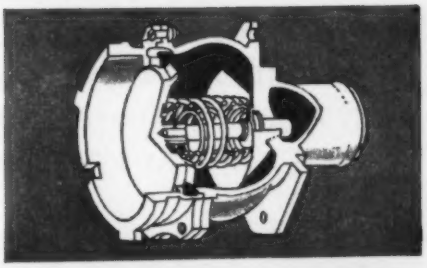
A new comprehensive range of aircraft mounted coupling units for aviation fuelling is now available ex stocks at A.W.E.

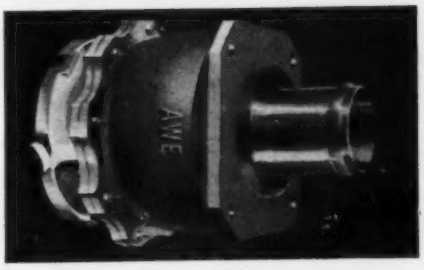
Combination of single seal and valve seat in the design reduces maintenance, spares holding, offers interchangeability of parts and provides a high degree of initial and operating economy.

The range comprises eight couplings with four types of outlets to each. Two sizes are available, either 1½ or 2½ inch outlets, all other parts being common to these. Special outlet connectors can be provided by arrangement.

Designed to Ministry of Aviation standards the couplings conform to International Standards Organisation and U.S. Military Standards requirements. The bayonet flange accommodates any of the approved kerosene or gasolene hose units.

A development of this design for handling H.T.P. is also available, complete with A.W.E. designed hose coupling.





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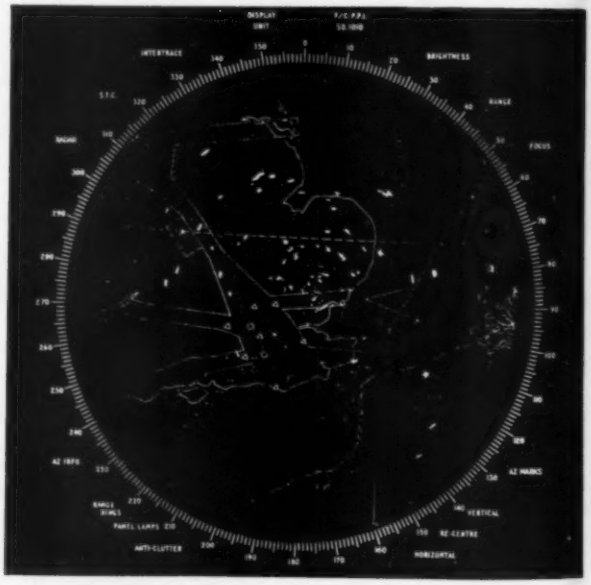

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Straight and Level

WISE words from Mr Alan C. Boyd, chairman of the US Civil Aeronautics Board:—"I shudder at any suggestion that the airlines have already corralled all the people who will travel by air. To sit down and simply figure out, on the basis of present traffic volume, how much of a fare increase is needed to cover expenses and a reasonable profit is, to me, an exercise in futility . . .

"The industry is all geared up and publicly committed to volume business, and price increases would be a novel means indeed of attracting volume."

● And from Mr W. Deswarte, general manager of Sabena:—

"Many of us have, this year, carried back and forth over the Atlantic, at high speed and tremendous cost, thousands of empty seats. From the standpoint of world economy this wasteful, sorry state of affairs is no better than the burning of wheat or coffee in the face of billions of starving people.

"It was easy to foresee that 1961, when all major carriers would be fully equipped with big jets, would be a disastrous year for the whole of our industry . . . But we did nothing about it, and many of us are now facing losses, aggravated by the unsolved problem of the unsold and unamortized Super Constellations and DC-7Cs and so many other excellent and relatively new turboprops or piston aircraft."

● Following on from the above, I am a little worried about the implications of the Air Transport Licensing Board's decision to turn down Silver City route applications because this airline does not appear willing to invest in new aircraft.

Surely it is not the job of a licensing authority to discourage the use of existing equipment? If an airline reckons it can make money with old aircraft, let it have a go.

● The other day in the House of Commons a Labour MP made the point, not actually new, that independent pilots are paid much less than corporation pilots. The logical progression of this line of thought, I suppose, is that independent pilots ought to be paid the same as corporation pilots when flying the same aircraft on the same routes.

Without going into the rights and wrongs of this argument, I cannot refrain from commenting on one implication of this campaign.

The implication seems to be that most independent pilots are spare-time chicken-farmers who climb into the cockpit still wearing their gum boots. But according to a table published by the pilots' union, BALPA, an independent-airline DC-3 first officer, who I suppose is the MP's idea of the lowest form of pilot life, gets £1,735 maximum, only £15 less than the MP.

● "My dear Blank, how good to see you." Britain's Minister of Planes, Mr Hugh Strangeways, settled down in a comfortable chair in the office of his Ruritanian counterpart. "I think you know what I've come to talk about," he began, drawing from his briefcase the Licensing Board's report awarding Potters Bar United Airways licences for services on all BOAC and BEA routes.

"The answer," said Mr Blank with a smile, "is no. You can't have any more traffic rights for London-Strelsau unless you cut the BEA and BOAC services proportionately."

"My dear Blank, surely we could meet each other half way on this? After all, we don't want to see BEA or BOAC undermined any more than you want Ruritanian Airways undermined."

"I'm sorry," replied Mr Blank, his smile vanishing, "but I have no more to say—unless, of course . . ."

"Yes?" asked Mr Strangeways.

"Well, you may have heard of something the airlines do called pooling."

"Pooling?" asked Mr Strangeways "Oh yes, yes, I've heard about that Pooling, yes."

"Let me explain," said Mr Blank, getting up from his desk, walking round to Mr Strangeways and, dropping his voice to a discreet whisper. "The airlines concerned put all their revenues into a pool and share it out on an agreed basis. Now, if Potters Bar United were to join this pool . . ."

"Ah," beamed Mr Strangeways, "I think I'm with you. Yes, pooling, what a splendid notion! I am sure that you have found the answer. I seem to remember reading somewhere that pooling means better service to the public by giving a more convenient spread of schedules, etc, etc, and that competition is not in the least diminished. Is that right, or was I thinking of something else?"

"No," said Mr Blank, "you are quite right."

The two men shook hands warmly, and went on to discuss a mutually convenient date for the introduction of take-off and taxying fees.

● Inadvertently omitted from the Airport Equipment section of this week's issue is Thinx Electronics Ltd, better known for such products as the Secrecy Revealer and the Meeting Simulator.

We forgot to mention the Super Gargantua filing cabinet, developed to a Ministry of Airports contract to hold 25 years of select committee reports, etc, on Britain's airports. "The filing cabinet and the committee," says a Thinx Electronics Press release, "are tools of major importance to Britain in maintaining supremacy in airport design." I understand that the Ministry has ordered 24 for evaluation.

Thinx, incidentally, are now working on a new collision-avoidance system for aircraft. They haven't *quite* got it right yet, but I can reveal that its name will be *absolutely* right—Kollidoscope.

ROGER BACON

Someone is right, someone is wrong. It seems to me that Mr Michael Walton (left) of Taunton and Mr John Davies (right) of Hastings could usefully pool their manpowered flight ideas. Assuming that both men are of roughly the same power, then a design having a C_L and gross weight somewhere between these two apparent extremes might well pedal off with the Kremer prize.

DHC-built Grumman Tracker of the Royal Canadian Navy being catapulted from HMCS "Bonaventure" during recent training in the Atlantic on anti-submarine duties

SERVICE AVIATION

Air Force, Naval and Army Flying News

New AOC Malta

MOVING from Bomber Command to a Mediterranean post, AVM J. G. Davis, CB, OBE, is now Air Officer Commanding, Malta, and Deputy Commander-in-Chief (Air), Allied Forces Mediterranean, from December 3. This appointment carries with it the NATO post of Air Deputy to the C-in-C, Allied Forces Mediterranean.

AVM Davis, who is 50, has been AOC No 1 Group, Bomber Command, since June 1959 and before that was SASO at the command headquarters.

Photographing Hurricane Damage

A PR mission is being flown over British Honduras by two Valiants of 543 Sqn to assess damage caused by hurricane "Hattie." Two aircraft from the squadron, which is based at Wyton, left for Jamaica on Wednesday of last week to operate from Montego Bay. They are working against a tight schedule, for despite adverse weather conditions at this time of the year, the photographs must be in the hands of Government assessors quickly if they are to be of any value.

Christmas Postmen

DELIVERIES of Christmas mail to ocean weather ships in the North Atlantic and to a lighthouse off Anglesey, North Wales, are being carried out by Shackletons and Whirlwind helicopters. A Shackleton of 203 Sqn, based at Ballykelly in Northern Ireland, is going out to *Weather Reporter* at station India (61°N 15°20'W) and to the Dutch weather ship *Cumulus*—the first time a Dutch meteorological vessel has been supplied—at station Alfa (62°N, 33°W), a total flight of 2,140 miles. This drop, by metal Lindholme canisters with drogues attached, is being carried out on December 20; and the following day two Shackletons of 201 Sqn, based at RAF St Mawgan in Cornwall, are going out to *Weather Adviser* at station Juliett (52°30'N, 20°W), 350 miles off the west coast of Ireland. Whirlwinds of 22 Sqn, based at RAF Valley, are flying out on Christmas Eve to the Skerries Rock off Anglesey, with Christmas mail for the three lighthouse keepers whose mail is now addressed "c/o 22 Sqn, RAF Valley."

Wessex Cross-operations

FOR the first time, Wessex helicopters have been co-operating with American aircraft in anti-submarine operations, in a recent exercise code-named "Lime Jug." The helicopters, from 819 Sqn, the Joint Anti-submarine School unit, have been embarked in USS *Essex*. Aircraft of RAF Coastal Command have also been participating in the exercise.

Treble-one's Dawn Patrol

WE held our annual squadron dinner not long ago (writes Rex Palmer, a First World War member of 111 Sqn). This year there were only three of us left, of those who flew in Palestine in the Allenby campaign of 1918. We had SE.5as—the fastest scout machine in the first war; maximum 120 m.p.h. on the level. They weren't called fighters then, though they served that purpose. We sat in a nice open cockpit, half-way down the fuselage, behind the 200 h.p. Hispano engine, with a Vickers gun fixed to fire through the propeller (with an interrupter gear, which didn't always work) and a Lewis gun on the top plane—normally firing forward as well, but you could pull it down by hand to fire upward. I tried it once in a vertical turn, when a German plane and I were trying to get on each other's tail; but firing across our mutual circle wasn't very accurate, and as he had an observer, who was single-minded and only concerned with shooting me down, I got the worst of the encounter.

I always liked the early patrol, when you took off before dawn and made your own sunrise. Climbing from Ramleh airfield still in the dark, we generally flew to Jaffa, to test our guns over the sea; then turned north up the coast to the line, which was then half-way to Haifa. At 10,000ft, I could see the top of Mt Hermon tinged with the new day, and to the east, the sun himself rising in splendour, though the land below was still wrapped in darkness.

But now I had to keep my eyes skinned and a rubber neck. Any pilot will tell you how fatally easy it is to miss seeing another plane, which may be quite nearby. If it is below, the camouflage makes it hard to see against the ground. Even if it is level with you or above, you may be blinded by the bright sky or even look right through it—because your eyes happen to be focused far beyond it. But you never forget the thrill when you suddenly spot a machine. Is it friend or foe?

The immediate action was to get between him and the sun; then he would have a job to see you coming in to attack. First you had to be sure of the black crosses on his wings, proving him an enemy. I once frightened a pal of mine from "A" Flight, who was flying independently from Sarona in a Nieuport Scout. I dived on him from a great height with my finger on the triggers and only pulled out when I saw the roundels on his wings. He hadn't even seen me till I flashed past him. Then we joined forces and did the patrol together. That was "Babe" Gledhill—he was only 19 and I a few years more.

Alas, he couldn't be at this squadron dinner. But there were two others of my vintage: Edgar Percival, who is still designing and building aircraft, and Shepherd, also an engineer, now retired from road transport. You can guess how proud we old ones were to meet the present-day pilots and ground staff of our old squadron. (If only they wouldn't call us "Sir.")

Our top speed in 1918 looks a bit silly now. Treble-one have got their Lightnings and can fly at twice the speed of sound—fifteen hundred miles an hour! But they seem quite ordinary fellows—like ourselves.

Things to come in Flying Training Command: the Air Minister, Mr Julian Amery, looking at a model of the Folland Gnat Trainer during his recent visit to the CFS, Little Rissington

IN BRIEF

The Air Minister was to visit RAF Finningley on Friday of last week to fly in a Vulcan B.2.

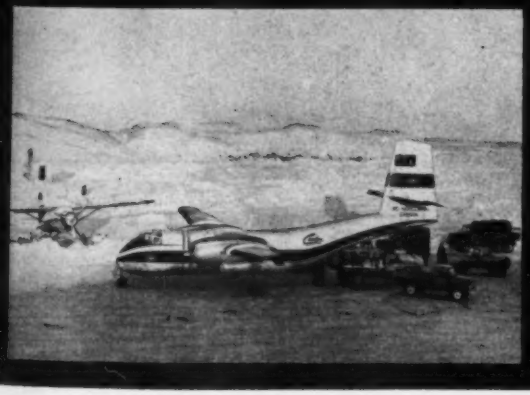
An Argus of 415 Sqn, RCAF, recently remained airborne for 30hr without refuelling on a 5,200-mile flight.

25 Sqn, which was until recently at Waterbeach, has moved to Leuchars. It thus becomes the second Javelin squadron on the station, joining 29 Sqn.

Thirty-two RAF officers who visited Buenos Aires in May last year on a goodwill tour have been awarded Argentine Air Force wings. They include AVM T. O. Prickett, who was force commander and is now Assistant Chief of Air Staff (Operations), and Wg Cdr J. H. Roberts, deputy force commander, who is CO of 101 Sqn at Waddington.

Maj Keith Groves, who presented the L. G. Groves Memorial Prizes and Awards for 1961 at Air Ministry recently, seen with his wife and two of the recipients, Sgt H. S. Carden (left) and Snr Tech L. Hodgkinson

OPERATION STOL



A SUPREME TEST OF CARIBOU TAKE-OFF AND LANDING PERFORMANCE . . .

Time: Midwinter 1961. **Place:** Resolution Island, above Lat. 60°N. **Operation:** 25,000 lb. of U.S.A.F. high priority freight to airlift from Frobisher. Round trip distance, 390 miles. **Carrier:** Nordair Limited.

Landing Strip: Length, 1300 feet. Width, not over 100 feet for half its length—walled in by banks of snow-covered rock 10 feet high. **Runway Extensions:** None. Sheer drop 800 feet, east end. Fall-off 300 feet west end.

Facilities: Strictly VFR.

Cross Wind: 25 kts., gusting to 30 kts., 60 to 90 degrees to the strip 70% of the time. **Turbulence:** Severe. **Average Temperature:** 24° below zero.

Operation Summary: MISSION ACCOMPLISHED.

The Caribou unloading at Resolution Island airstrip, which lies contained throughout its entire length within the circle (upper photo). Wheeler Airlines' Otter (background) uses the strip regularly.

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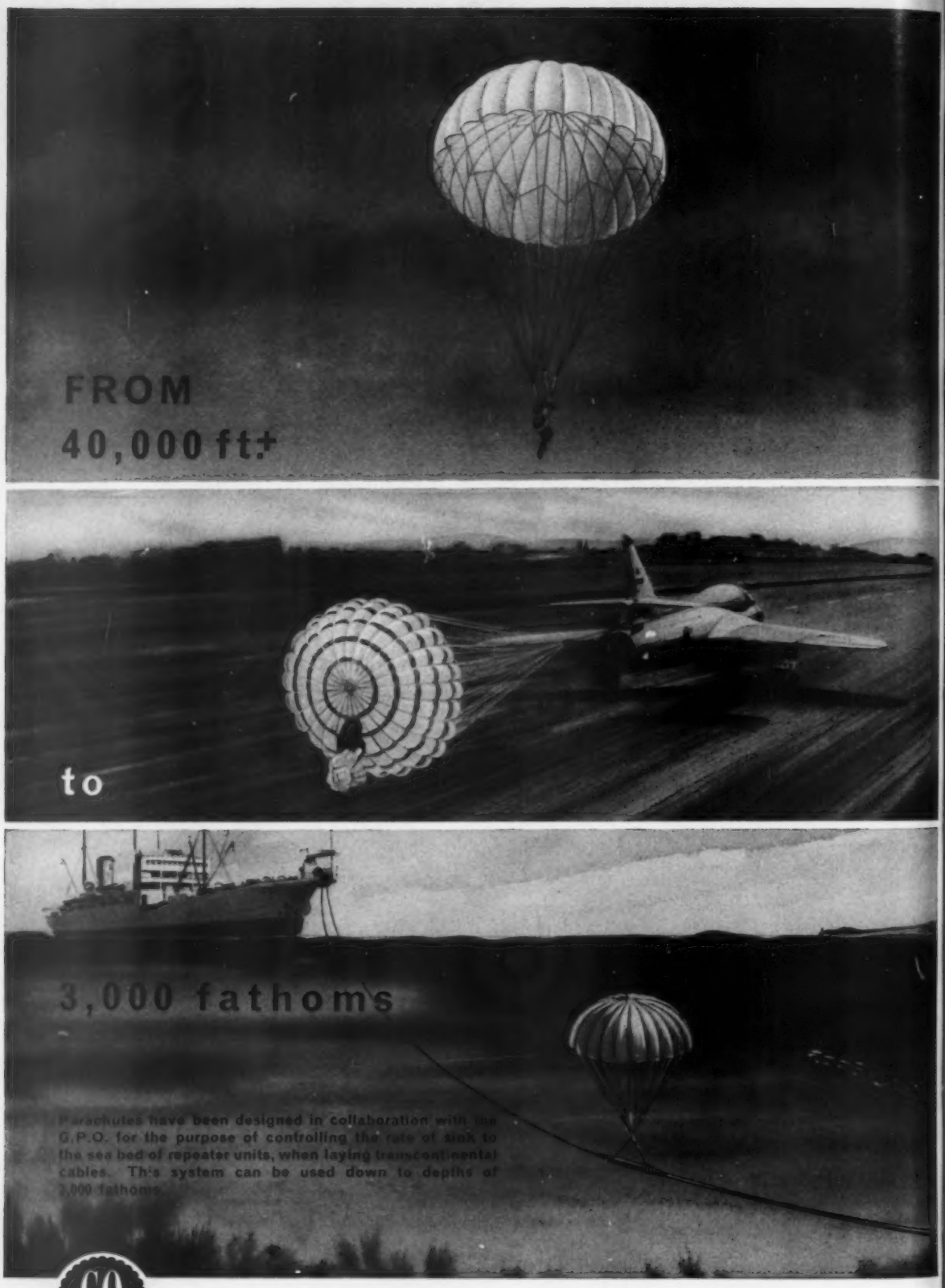
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40,000 ft.+
to
3,000 fathoms
Parachutes have been designed in collaboration with the G.P.O. for the purpose of controlling the rate of sink to the sea bed of repeater units, when laying transcontinental cables. This system can be used down to depths of 3,000 fathoms.

G. Q. PARACHUTE COMPANY LIMITED
STADIUM WORKS · WOKING · SURREY · ENGLAND

"Flight" photograph

This detail, from a larger picture in the same series as those on pages 914 and 915, shows (on the left) London Heathrow's new long-haul terminal, subject of the article which begins below

A New Front Door for Britain

London Airport's Long-haul Terminal

BY G. S. HILL, *Assistant Secretary, Aerodromes Planning (A), Ministry of Aviation*

ON November 13 thirteen airlines began to use the first half of the new long-haul passenger building in the Central Area at Heathrow. To start with, it is being used for departures only by BOAC and the airlines they handle, their arrivals being routed through the short-haul terminal. This can be done without overcrowding during the winter months, because traffic is lower and the long-haul and short-haul traffic peaks occur at different times. The other long-haul airlines will continue to use the north terminal until next spring, when the remainder of the passenger building and the first of the two office blocks will be finished. Work has just started on the second office block, and the whole terminal is expected to be finished early in 1963.

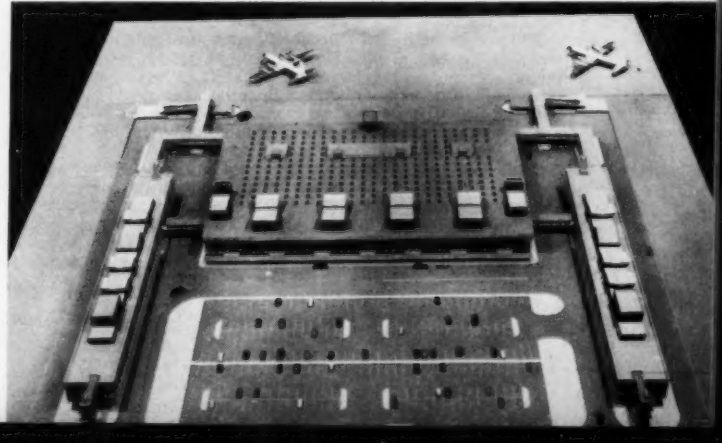
The basic ingredients of a successful terminal are, first and most important, the ability to handle passengers and baggage quickly and smoothly. Although the objective must always be to enable the passengers to pass through the building as quickly as possible, there must be adequate and comfortable waiting space, particularly when flights are delayed by bad weather or other causes. Restaurants, bars and shops must be provided for those who have time to spare (and money to spend), as well as banks and counters for car hire, hotel reservations, etc, to help passengers with their travel arrangements. Finally, at a major international airport such as Heathrow there are inevitably prestige considerations, and the design and finish of the building must be a credit to the country for which it is the gateway.

We shall not know till next summer how far the new terminal will meet these requirements; then all the long-haul airlines will be using the building and we shall have our first experience of peak traffic. The design is, however, the result of a very thorough study of traffic forecasts and passenger handling methods at home and abroad, and the planners are confident that it will prove successful. The detailed requirements have been worked out in close co-operation with the airlines, particularly BOAC. In addition, it has been possible to draw on the experience of new terminals at foreign airports, whose administrations have been most helpful in providing information about the design of these buildings and the difficulties encountered.

The terminal in its final form will consist of a rectangular passenger building, 430ft by 280ft, connected by bridges to two separate blocks, each 410ft by 55ft, housing airline offices and other facilities. It is on the south-west side of the Central Area but some distance outside the original diamond. This site was recommended by the Millbourn Committee* in order to provide more space for roads and car parking and to allow more aircraft stands to be adjacent to the terminal. This imposed the first limitations on the design, since the height had to be restricted so as not to obstruct the view of the taxiways from the control tower. This meant that the passenger building could basically have only two storeys compared with the three of the short-haul terminal. (The high water-table at Heathrow makes it expensive to build underground and it was, therefore, considered impracticable to provide a full extra storey in the basement.) To handle all passenger movements at one level would have required a wider site than was available, and it was

*Report of the London Airport Development Committee, 1957 (CAP145, Her Majesty's Stationery Office).

The real thing has fulfilled the promised attractiveness of the model, first displayed by the architect, Mr Frederick Gibberd, in April 1960



Baggage sorting and loading is the responsibility of the airlines. BOAC are using a mechanical sorting system and have installed a conveyor belt which by means of hydraulic arms directs baggage for various services to specific collection points. Arriving baggage is brought from the aircraft by the airlines to the airside unloading area. There are ten unloading points, from which baggage is taken direct by conveyors into the Customs hall.

The building will be well equipped with amenities for passengers and their friends. Perhaps the most striking features are the long balcony lounge on the first floor, which will provide an open waiting area away from the main passenger flow, and the viewing gallery on the roof. This latter is open on the side overlooking the apron and glazed on the inside to allow friends in the public area to see arriving and departing passengers in the airside lounge. It is proposed to make a small charge for admission (by means of a coin-operated turnstile), partly to provide an additional source of revenue and partly to control access to the gallery and prevent

View of the exterior, showing the main entrance (the Stefan Knapp murals have yet to be installed). Below, the main stairway in the ticketing hall

A New Front Door for Britain . . .

therefore necessary to use both storeys for passengers. This in turn required airline offices and the main restaurant to be provided outside the passenger building but to be connected with it. The site, also, was too small to allow of a two-level road system in front of the building.

Several layouts were tested on paper, and the final choice fell on the U-shaped complex shown in the photograph of the model. The south office block includes an entrance for coach passengers arriving at the airport from London and this adds to the landside frontage of the building. The layout also provides an open forecourt for setting down and picking up passengers in front of the building and for car parking.

The general arrangements for handling passengers are shown in the diagram. They are as flexible as possible to cater for the large passenger-loads of today's aircraft and the even larger ones of the future. This is particularly important with long-haul operations, where the average size of the aircraft is greater. It is expected that by 1970 the airport will be handling three million long-haul passengers a year, with a standard busy rate of about 1,500 an hour. (The standard busy rate is the hourly rate of movement equalled or exceeded during 30 hours in the peak summer months and gives a useful measure of near-peak conditions.)

Departing passengers travelling to the airport by coach, who have already checked in at the town terminal and had their baggage weighed, go direct to the first-floor concourse, either by the staircase just inside the main entrance or via the entrance in the south office block. Those coming independently check in at the airlines' counters on the ground floor and hand over their baggage. They then go upstairs and immediately opposite the top stairs come to the Immigration and Customs "comb." (Customs inspection is carried out on occasional outgoing flights, and facilities for inspection of baggage are provided in the ticketing hall for passengers making their own way and in the south office block for coach passengers.) After passing through the controls the passengers enter the departures lounge and wait there until their flight is called; they are then directed along the airside gallery to the aircraft. For the present, access to the aircraft will be via the two ramps visible in the photograph, and except to the nearby stands passengers will be conveyed by bus. The airside galleries in the office blocks will be brought into use later to serve the stands opposite, and plans for further piers (covered walkways to the aircraft) are now being worked out.

Arriving passengers move via the airside gallery into the arrivals lounge, passing first through Port Health inspection if this is required. From the lounge they pass through Immigration and then go down stairs into the Customs hall. Here they collect their baggage and, after Customs inspection, board the coaches at the front of the building or go to their cars.

The aim for both arrivals and departures is to maintain as simple and direct a flow as possible. Experience has shown that with a rapidly developing industry such as air transport, techniques are continually changing, and every effort has been made to keep the building as flexible as possible, so that changes in methods can be made without major structural alterations. To this end extensive use has been made of demountable partitions.

Little need be said about baggage handling, because the system is so simple. On departures, "coach baggage" will be taken straight to the sorting area of the landside by the road between the passenger building and the south office block. The baggage of passengers checking in at the airport will be taken direct from the ticketing hall by conveyors at or below ground level to the sorting area.

congestion, since it would be wrong to allow spectators to impede the flow of passengers. Another special facility is the nursery, which will no doubt prove as much appreciated by harassed mothers as is the one in the short-haul terminal. It comprises a spacious, well-equipped playroom, lavatories, cots and feeding cubicles. A qualified children's nurse is in attendance from 8 a.m. to 10 p.m.

The building will have ample catering facilities. There is a quick-service restaurant and a cocktail bar on the first floor. The main restaurant, where the public can lunch and dine at greater leisure, together with another cocktail bar, will be in the south office block. In the airside departure lounge there is a bar, open day and night. In the departure lounge is a shop for the sale of duty-free liquor, a concession that has been extremely popular, particularly with American visitors. Other shops, bookstalls, banks, post office, etc, are located in the lofty entrance hall and on the first floor.

One point about the building that may arouse comment is the absence of escalators. The average Londoner is used to escalators and appreciates them, but many passengers from abroad dislike or even fear them, and there has been a surprising number of complaints about those in the short-haul terminal. They are expensive to install and maintain and they take up valuable space. As the rise in the new building is only 13ft, which can easily be negotiated on a wide stairway, it was decided after careful consideration not to provide escalators at the outset, though they can be installed later if necessary. There are lifts on both sides of the building for disabled and infirm passengers.

A special suite for the reception of Government-sponsored VIPs will be located under the finger leading to the north office block. It will be possible to handle two separate parties simultaneously. For special occasions, such as the arrivals and departures of visiting Heads of State, spectators will be admitted to the roof of the adjoining north office block to view the proceedings. Some of the airlines will also have their own lounges in the office blocks for the passengers that they delight to honour. A press and television interview room will be provided on the ground floor of the office block immediately next to the VIP suite.

The use of large jet aircraft close to the buildings presented special problems of noise and fumes, and we received most helpful advice from the Department of Scientific and Industrial Research. In order to reduce noise, all offices will have double glazing, and provision has been made for this to be added in the passenger areas if it proves necessary. The roof of the passenger building, although not designed to bear heavy loads, has been made of materials sufficiently dense to absorb the noise from aircraft already above roof level on take-off. This requirement had to be combined with the provision of as much natural lighting as possible; the ingenious design of the roof lights, with double Perspex domes, wired-glass lay-lights, and sound-absorbent walls in the apertures, constitutes an attractive and efficient solution. As a further measure to reduce noise on the airside, carpets have been used extensively. Efficient sound-proofing of a building of this size required a virtually sealed structure, which in turn entailed mechanical ventilation. The system provides six changes of air an hour, a high standard. Activated-carbon filters are installed to keep out paraffin fumes. Certain areas such as the restaurant and the VIP suite will also be artificially cooled, but it was not considered that the British climate justified imposing on the taxpayer the very high cost of fully air-conditioning a building in which passengers will stay only a short time.

Though carpets are used in the lounges, elsewhere in the public areas marble tiles and rubber flooring have been laid. Special attention was in fact paid to all finishes, and much of the furniture, too, was specially designed. It has been by no means an easy task to reconcile a becoming appearance with functional efficiency, reasonable initial cost and economical cleaning and maintenance. Perhaps the best testimonial to the correctness of choice will be if the public take for granted the unobtrusive yet durable materials used.

The first half of the building now in use contains a number of light temporary structures, such as the VIP room in the airside lounge and the offices on the balcony. The latter in particular destroy the full effect of the balcony design. The architectural qualities of the building cannot, therefore, be fully assessed until the whole complex has been completed and all the temporary installations removed; but it should be possible to get a better idea next spring when the passenger building is finished and the full spaciousness of the interior can be appreciated. Externally, probably the two most striking features will be in the façade and the outline. There will be a series of abstract murals in enamelled steel by a distinguished artist, Stefan Knapp, on the 10ft-square panels on the front of the building. These will add colour and harmonize with the contemporary nature of the design. Another distinctive feature, which has already provoked some comment, is the bold treatment of the plant-rooms on the roof. The design of the terminal as a whole passed the scrutiny of the Royal Fine Art Commission.

An important requirement in the design of a passenger terminal is the provision of sufficient space for vehicles to set down and pick up passengers without causing congestion and delay. This was proving a serious limiting factor in the capacity of the short-haul terminal, and earlier this year an experimental road layout was introduced. It consisted of a number of islands and separate lanes in front of the building. This arrangement seems to be working well, and it is proposed to provide a similar arrangement in front of the new building. The Ministry has, however, recently commissioned an eminent firm of traffic engineers to examine the whole of the road pattern in the Central Area, including the loading and unloading areas for the buildings, and the precise layout for the new terminal must await their report; there is ample space in the forecourt.

Some idea of the attractive styling of the interior is gained from this view of the airside departures lounge

Work started on the foundations of the passenger building in October 1959; and, as stated earlier, the whole terminal is expected to be finished early in 1963. The total cost will be about £3m.

Functional requirements for the terminal were formulated by the Ministry of Aviation in consultation with the airlines. The contracts were placed by the Air Ministry on behalf of the Ministry of Aviation, and the work has been supervised by the Air Ministry Works Department. The architect is Mr Frederick Gibberd, CBE, ARA, FRIBA, MTPI, FILA, who was also responsible for the design of the other buildings in the Central Area. The consulting engineers are Sir William Halcrow & Partners, in association with G. H. Buckle & Partners for the heating, ventilating and electrical services, and the quantity surveyors are Franklin & Andrews. Principal contractors for the passenger building were Gilbert-Ash Ltd (foundations), Robert Watson & Co (Constructional Engineers) Ltd (steelwork), and Taylor Woodrow Construction Ltd (main superstructure). The south office block is being built by Pauling & Co Ltd, and the VIP suite and north block by George Wimpey & Co Ltd.

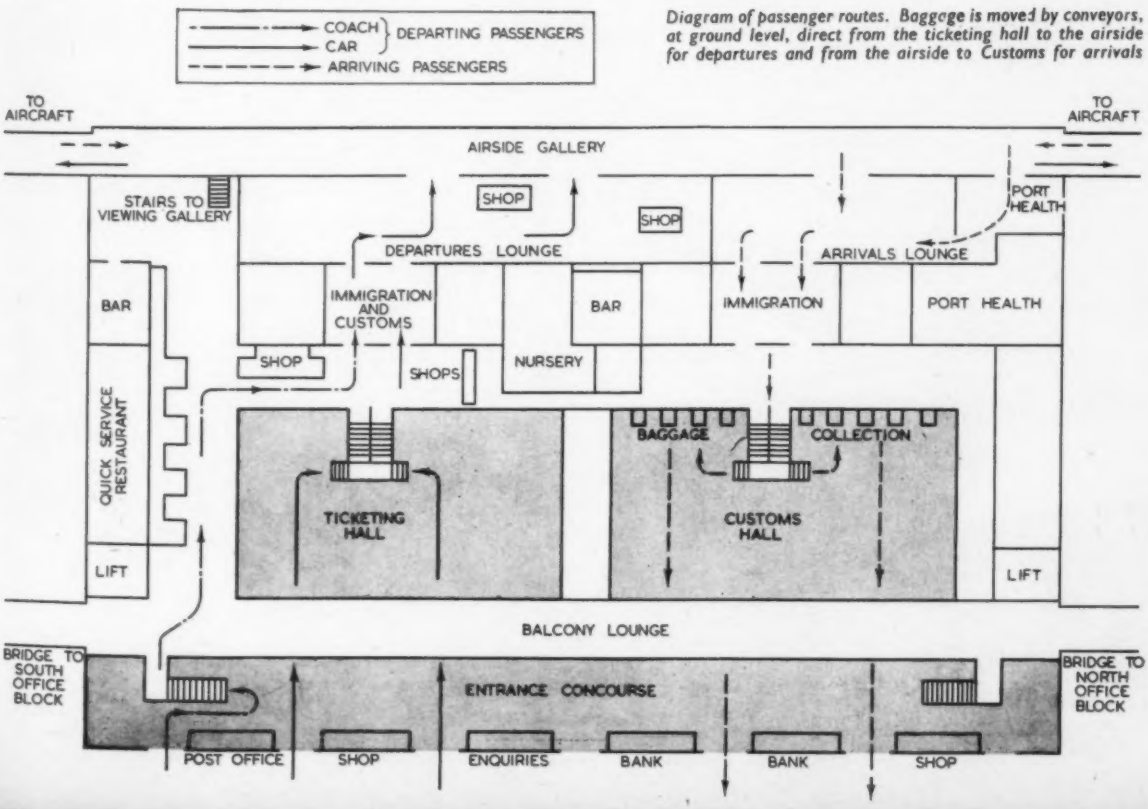


Diagram of passenger routes. Baggage is moved by conveyors, at ground level, direct from the ticketing hall to the airside for departures and from the airside to Customs for arrivals

With the minimum of fuss and formality the London air traffic control authorities recently allowed "Flight's" Gemini a few minutes' freedom of the skies above Heathrow and Gatwick airports. On board was staff photographer Ian Macdonald, and these are two of the pictures that resulted. On the right is Gatwick, dispersed round the pier being (l to r) a British United Viscount, BEA Viscount,

OVERHEAD LONDON

Jersey Airlines Heron and a Maritime Central Herald. Also identifiable in the original photograph are a Trans-European Constellation, Cunard Eagle DC-6C, Dan-Air Ambassador, two World Wide DC-4s and an Air Safaris Hermes. In the distance, on the left, is the British United Airways base; in the centre is the former Overseas base. London Heathrow Central, with the new long-haul terminal to the left, is the subject of the picture below. Among the aircraft on the short-haul apron, most of which belong to BEA, are four Vanguards.

Chile "charges for each radio beacon used": a Comet 4 of Aerolineas Argentinas over Los Cerrillos, Santiago

WHO PAYS WHO AND HOW MUCH: BRITAIN AND AMERICA TO JUMP ON THE WAGON?

EN ROUTE AIR NAVIGATION CHARGES

By G. L. Marchault

LANDING FEES have been greatly in the news during recent months and strong views on their compatibility have been widely aired; fuel and ticket taxes, too, have also received their share of publicity. But one further charge to which aviation is subject has been almost completely ignored: the fee levied for the use of navigation facilities, communications, *en route* aids and the like. Such a fee is generally styled an "air navigation" or "*en route* facilities" charge.

The recent rumpus that has blown up in Canada, where the Government has sued several airlines for non-payment of such charges, has focused attention on that country in particular. A few people may be aware that similar charges, although of lesser magnitude, are also made in Malta and the Sudan. A few others might hazard a guess that they are also applied in one or two South American countries, although they probably could not name them. It may, then, come as a distinct surprise to learn that, at the moment, no fewer than 27 countries have adopted this method of raising extra revenue and that at least two or three others, including the USA, are considering their introduction.

The countries now charging such fees are listed below. For greater clarity the various currencies have been converted into sterling to save the reader having to wrestle with a welter of guaranis, kyats, pesos and escudos.

ADEN. A fee of 10s is charged for each H/F contact made on a particular channel.

ARGENTINA. Charges are made for services including air traffic control, aeronautical fixed and mobile services and radio navigation service. They are based on the cost of operation of the services, frequency of flights and proportion of services used. Scheduled operators pay 50 per cent of cost and, when a route is shared by more than one operator, the 50 per cent is shared between them. The official estimated monthly cost of operating Ezeiza radio installations is given as £4,500. Non-scheduled operators pay about 5s for each flight and for each radio installation used.

AUSTRALIA uses a system which serves the dual function of landing fee and air navigation charge. Aircraft are classified by weight categories and then pay a flat rate per 1,000lb multiplied by a route factor which increases according to the length of the flight. For example, an aircraft of 150,000lb flying from Canberra to Darwin would pay: 10½d (weight category) × 150 (a.u.w. in 1,000s) × 10 (route factor) =£A65 12s 6d, or about £52 10s.

BAHAMAS. All aircraft owned and operated by a commercial or an industrial company, whether flying for hire or reward or not, pay a telecommunications charge as follows: *Casual users:* Less than 20 C/W messages per calendar month, 15s per message (which must not exceed 20 words). *Regular users:* More than 20 C/W messages per month are charged on a pro-rata basis.

BARBADOS. Scheduled users are on "contract" rates. Casual users are charged: £5 4s for air/ground/air service per landing or overflight; £2 15s for navigation aids per landing or overflight; 8s 4d per message of 20 words or part thereof.

BRITISH GUIANA charges contract rates for scheduled operations, whilst casual users are charged: £1 13s 3d for air/ground/air service per landing or overflight; £2 1s 7d for navigation aids for landing or overflight; 8s 4d per message of 20 words or part thereof.

BRITISH HONDURAS operates a sliding scale based on the number of landings per month. For communications and radio aids, one to five landings are charged at £3 each; six to ten cost £2 15s each; and for 11 upwards the fee is £2 10s each. Point-to-point messages are also on a sliding scale, ranging from 7s each for the first 50 down to 4s for 401 and upwards.

BURMA makes the following operational charges for use of Rangoon FIR air navigation facilities by aircraft flying over or through its territory: Light aircraft carrying purely VHF R/T, 15s (Class A); privately owned aircraft with full radio, £3 15s. (Class B); Charter and/or common carrier, £15 (Class C). There are also movement charges: Class A, 7s 6d; Class B, £1 15s; Class C, £7 10d.

CANADA. A telecommunication charge of £6 18s is made for each flight where an aircraft is engaged on an Atlantic, Caribbean, Pacific or Polar flight, or any of them, and communicates with a Canadian international communications station. Additionally there is a route facility fee of £22 2s for an Atlantic or Polar flight.

CHILE charges for each radio beacon used, and the rate varies with the ownership of the beacon and the number of times it is used. There are also fees for communication facilities, domestic flights being charged at one of the three aircraft weight categories, whilst international flights are charged at one of two rates according to weight. In each case there is a 100 per cent surcharge for night operations. (It would be too much involved to attempt to work out an example, especially as there are three different rates of exchange.)

COLOMBIA. Charges are made for radio facilities at a flat rate of so much per kilogramme of aircraft maximum gross weight per hour flown. Fractions of an hour are charged proportionally. A Comet 4, flying for one hour, would pay approximately £1 12s.

CUBA is unique in charging only a fee for meteorology, of about £1 16s per flight.

EAST AFRICA. The following navigation charges are made for each flight through, or into, the territories, or each 24hr period of flight within the territories: Single-engined aircraft, multi-engined, maximum of less than ten permitted passengers, £1 10s; More than ten permitted passengers, £2; All up weight in excess of 20,000lb. 2s per 1,000lb or part thereof. There are also annual rates available, e.g., less than ten passengers, £30.

EGYPT charges 15 per cent of the normal landing fee for every aircraft overflying its territory irrespective of the number of communications with ATC. Normal landing fee for a jet aircraft is 1½ × 25 milliemes × 100s of kg a.u.w. Comet 4 landing fee is about £23, thus the communications charge would be £3 9s.

ETHIOPIA charges only for use of facilities outside published hours of operation; 28s 4d per hour is payable.

GUATEMALA charges for weather forecasts, weather reports from any station, radio service (flight watch) and departure and arrival messages. Typical bill: £3 15s.

HAITI charges for radio watch, radio messages, meteorological forecasts and terminal forecasts. Typical bill: £4 2s.

IRELAND. Here a charge is made for transoceanic contacts with Shannon Radio Station. This charge varies from month to month and is arrived at by dividing the average monthly cost of providing the service by the total number of contacts for the month.

MALTA. An *en route* charge, which varies with aircraft weight, is incorporated in the normal landing charges for Luqa. Where aircraft fly through the Malta FIR without landing at Luqa (or elsewhere) the standard charge is increased by 50 per cent. The standard charge varies from 5s for 5,000lb up to £8 for 200,000lb or over.

NEW ZEALAND. There is a flat rate of £20 for "airways dues" for each international flight taking off from any New Zealand airfield. Domestic operators are required to pay 5½ per cent of the gross operating revenue from all flight operations unless the aircraft weighs less than 12,500lb, in which case the levy is 2 per cent. For operations other than air transport the rate is reduced to 1 per cent, whilst training flights by clubs pay no dues.

NICARAGUA. Navigation facility charges are on a sliding scale, by weight, ranging from £1 16s for aircraft of 5,000lb-10,000lb to £25 for aircraft of 200,000lb, with a 25 per cent surcharge for night operations.

PARAGUAY charges only for control tower services, basing the charge on the type of aircraft, number of passengers and number of movements each month. A typical charge for a DC-6 with up to 65 passengers, and making 30 landings per month, would be 12s 4d per landing.

PERU. Charges for the use of aerodrome and communications facilities are assessed by aircraft type, e.g., a DC-7B pays about £2 8s.

SUDAN. Charges are according to the weight bracket of the aircraft and the type of flight:

	International	*Internal*	*Overflying*
Over 30,000lb a.u.w. ..	£10 5s	£4 2s	£20 10s
Under 30,000lb a.u.w. ..	£5 2s 6d	£2 1s	£10 5s

SYRIA. Unless a landing is made at a Syrian aerodrome the overflying charge is just under £5.

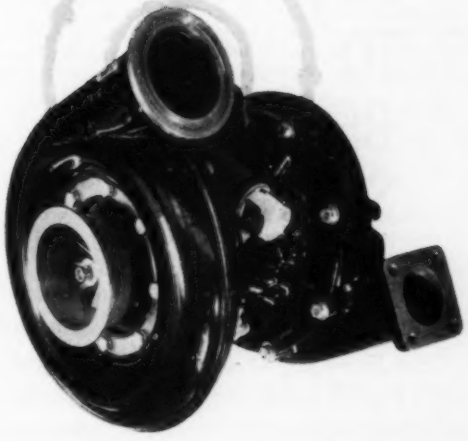
TAIPEI makes communication/navigation-aid facilities and meteorological service charges. Scheduled aircraft pay 20 per cent of the

FOR THE VICKERS VC.10....

NORMALAIR VAPOUR CYCLE COOLING

A NORMALAIR vapour cycle cooling system—featuring exclusive, all-pneumatic controls—has been chosen for the Vickers VC.10, the first British civil aircraft to have this type of system as standard equipment. Big advantage of all-pneumatic controls are that, through system simplification, they greatly improve service reliability and make maintenance much more straightforward.

The refrigeration capacity of the system is 30 tons, and full 'rated' performance is maintained even with the aircraft engines running at only 'taxying' power. The single-stage centrifugal compressor around which the system is built is suitable for any application calling for a refrigeration capacity in the 15/20 ton range; two are used in the VC.10.



The NORMALAIR single-stage centrifugal compressor used in the VC.10.

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Europe's largest and most experienced producers of aircraft cabin air conditioning systems and components

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Photo: Science Museum, London.

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V.1000CB	750
A.175	1,500
L245	2,250
V.1001	3,000
L300	5,000
L246	7,500
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actual expenses (cost, less income from transit aircraft) of Taipei Aeronautical Communications Station and Shungshan Weather Station on an average basis if they make revenue stops at Taipei. The remaining 80 per cent is paid by the airlines in proportion to the number of flights and mileage between Taipei and other airports during the month. Non-scheduled flights are each charged at £3 11s for communications and £1 15s 6d for meteorology.

YUGOSLAVIA. Charges are made for navigation facilities according to the route flown. Figures vary from £6 16s to £13 18s.

Britain Too?

IT is common gossip that the Ministry of Aviation, with Treasury prodding, has for a long time been considering the imposition of some such charge. Airlines are busy speculating on just how much it will be and how it will be assessed. To be a workable proposition any levy of this kind must fulfil several conditions. The main considerations can be summarized as follows: (*a*) the charge should be proportional to the benefits received; (*b*) it should be free from unnecessary complications; (*c*) the administrative processes involved should not require a large number of extra staff or elaborate book-keeping or billing; (*d*) costs of collection should be a negligible percentage of the receipts.

Since at least two, or even three, of these considerations are alien to conventional bureaucratic procedures it remains to be seen just which particular method the UK will adopt. It may be a straight copy or an adaptation of one of the methods quoted for other countries; or, if the system used for landing fees is any indication, it might be something new. Whichever scheme is adopted one can be sure of one thing: the airlines will scream long and loud. One can sympathize with their attitude, but at the same time one must concede that the ever-increasing costs of air traffic services and allied equipment are due entirely to the increasing speed and size of modern aircraft and the steady growth of traffic. These must be paid by someone, and the Treasury is becoming more and more convinced that it is not that someone.

If and when the charge is introduced perhaps justice could be done to internal flights by removing the iniquitous tax of 2s 9d per gal on petrol used on such flights. Incidentally, paraffin pays only 2.20d per gal, which seems hardly equitable. There seems little rhyme or reason behind this; or is it too much to expect that taxation, in any form, should ever make sense?

And the USA?

EVER since 1945 the United States Government has been considering a user charge for airways facilities. It was put forward by Mr Truman in 1947; by General Eisenhower in 1957; and thereafter specific proposals were made in the Presidential "budget message" for the financial years 1959, 1960 and 1961.

As far back as 1954 the House Committee on Appropriations said: "This committee has year after year called attention to the fact that the Federal Government is providing huge sums for airways facilities and operations without reimbursement from the aircraft industry. The committee does not propose to continue indefinitely making recommendations for such large appropriations unless some system of airways charges is placed in effect which will return a substantial sum to the Federal Treasury. Action and not mere promises is what is needed and expected."

Aviation gasoline pays a Federal tax of 4 cents per US gal, of which 2c is refunded under provisions contained in the Internal Revenue Code whilst the remaining 2c (i.e., about 1¼d per Imp gal) is transferred to the Highways Trust Fund. Jet fuels pay no Federal tax. Several States levy their own individual taxes, but these are not relevant to the present discussion.

Various schemes for raising revenue to pay for the airways have been considered. They ranged through:

(*A*) *Direct charges*, by which a specific charge would be made for each flight-plan filed, each radio contact made or each part of the airways system used; but the administrative problems of assessing equitable charges, together with a possible reduction in air safety, ruled against this scheme. One can imagine some operators refusing to use all available facilities because of the cost.

(*B*) *Gross ton-mile charge* for aircraft of over 4,500lb a.u.w; but to calculate this for 9,500 aircraft would be an unenviable task. Aircraft of under 4,500lb would pay an annual registration fee according to gross take-off weight (and there are about 68,000 such aircraft).

(*C*) *Aircraft mileage charge*, revenue ton-mile charge and a gross revenue tax: all there were considered but found wanting.

(*D*) *Charge on each ticket or way-bill.* This would automatically leave out private and executive aircraft. In any case, there is already a 10 per cent Federal tax on all forms of transport which is not allocated to any specific purpose or fund.

Almost every variation and permutation of these schemes was examined; but, judged against the criteria of equity, ease of collection and safety none of them was considered satisfactory.

The President, in a special tax message sent to Congress on April 20 this year, recommended that the present 2c/gal tax on aviation gasoline be extended to jet fuels, that revenue from both should go towards financing the airways system and that legislation should provide for annual increments of ½c/gal on aviation fuels until the portion of the cost of the airways properly attributable to domestic civil aviation was substantially recovered by this tax. This recommendation implements, in the field of aviation, the Federal Government's general policy of imposing user charges in all areas where a Government service provides special benefits to individuals or groups. It is, perhaps, a significant pointer that the Federal tax on gasoline or diesel oil for road-vehicle used was raised from 2c/gal to 4c/gal on August 28, 1958, and this revenue is used for financing new road programmes (a contrast to the 2s 9d per gal in this country, which finances who knows what). The President has recently recommended a further increase.

It seems inequitable that jet fuel should have escaped tax, particularly since its consumption is increasing rapidly while the consumption of gasoline is decreasing at almost the same rate. At America's present rate of 2c/gal the yield from gasoline was estimated at $29m in 1960, and this figure is expected to drop at the following rate: 1961, $24·1m; 1962, $20·3m; 1963, $18·3m; 1964, $16·4m; 1965, $14·5m; 1966, $13·5m.

This proposal would relate only to domestic movements, i.e., any flight which has both its origin and destination within the 50 States. The concept of charging aircraft engaged in international aviation is specifically excluded. Military aircraft are likewise excluded, because there would be no net gain to the Government but only expenses for book-keeping transactions. However, the substantial use made of the airways system by military aircraft has been taken into account and their share of the cost is assessed at 29·9 per cent, leaving 70·1 per cent to be allocated to civil aviation.

The Federal Aviation Agency has examined the fairness of charging the same rate for gasoline as for jet fuel. In their report they state that a Boeing 707 burns about 2,250gal/hr, a Douglas DC-7 about 570gal/hr and a DC-3 about 100 gal/hr. When these figures are converted into gallons of fuel burned per revenue ton-mile or per passenger ton-mile the differences are surprisingly small:—

	Gal/revenue ton-mile	*gal/passenger ton-mile*
DC-3	0·739	0·074
DC-4	0·539	0·055
DC-7	0·491	0·048
B-707	0·533	0·055

Furthermore, the FAA claims that jet engines are becoming more efficient, that operators are learning more economical use of them, that jet fuel is generally 6 to 8 cents per gal cheaper than gasoline and, finally, that the increased cost of the airways is due in a large part to the more critical requirements imposed by jet aircraft.

During 1959 aviation used 230m gal of jet fuel. In 1960 this had risen to 789m gal (about $15¾m of potential revenue at 2c/gal) and it is estimated that consumption will rise to 1,685m gal in 1962 and 2,675m by 1966.

The cost of the airways system was calculated by the FAA by taking the maintenance, operational and administrative costs, allowing for depreciation of equipment and buildings, adding costs of maintaining and operating flight checking aircraft, adding

"Aviation gasoline pays a federal tax of four cents per US gal": refuelling and apron services at Newark Airport, NJ

General aviation in the USA: Piper Aztecs leaving the PAC ramp at Lock Haven, Pennsylvania, on delivery flights

amortization of long-range research and development costs and, finally, interest at 3½ per cent on the unamortized investment. The total estimated annual costs are shown in Col 2 below. The estimated revenue to be obtained from taxing all aviation fuels at 2c/gal in 1962 and thereafter increasing the rate of tax by ½c/gal each year until it reaches 4c/gal in 1966 is shown in Col 4:—

Year	*Airways costs*	*Civil share (70·1 per cent)*	*Fuel tax revenue*	*Percentage of cost recovered*
1961	$379·7m	—	—	—
1962	$431·4m	$302·4m	$54m	17·9
1963	$479m	$335·8m	$72·5m	21·6
1964	$523·6m	$367·1m	$91·5m	24·9
1965	$558·3m	$391·4m	$112·0m	28·6
1966	$594·8m	$417·6m	$134·0m	32·1

To recover the full amount of the airways costs attributable to civil aviation would need a fuel tax on all fuels of 11½c/gal (about 8¼d/Imp gal) in 1962 and 12½c/gal (about 9d/Imp gal) in 1966.

According to the FAA, a 2c/gal tax on jet fuel in the fiscal year 1960 would have increased the total operating expenses of America's 12 major domestic carriers by 0·8 per cent. These 12, between them, would be liable to pay 75 per cent of the domestic airways charges. A 3c/gal tax on all fuel (i.e., an extra 1c/gal on the existing gasoline tax and 3c/gal on the hitherto untaxed jet fuel) would have increased expenses by 1·7 per cent. Taking a realistic attitude, the FAA says that this increased cost can be met either "by seeking additional revenues through increased passenger fares and freight rates or by reducing other expenses in sufficient amount through increased operating efficiencies."

Since February 1958 the domestic trunk route carriers have effected a series of fare increases which have raised the level of fares by about 20 per cent. FAA opinion is that another small increase, if essential to pay for airways charges, would not divert existing (nor discourage new) traffic, as the amount of the increase would be very small. For example, 2c/gal on jet fuel would raise the existing fare on the Los Angeles/New York B-707 service by $2·97 (now $181·45). The local feeder services receive subsidies and the only effect of an airways charge in their case would be an increase in their subsidies.

It seems that the 33 supplemental carriers, operating under interim authorization from the CAB, will be the hardest hit. As a group they sustained net losses in 1959 and 1960. Presumably they will suffer further losses in the future.

Comment by a US airline executive: "For every passenger we carry we net two cents and the Government gets four dollars."

What of America's "general aviation," which covers corporate, business and personal flying, together with such activities as crop-spraying and pipe-line inspections? The total hours flown by this category have increased by 51 per cent between 1952 and 1959, but the FAA estimates that users will not suffer unduly. Each ½c/gal tax will add 5c/hr to the cost of operating a Cessna 150 (single engine, two seats); 7c/hr to a Cessna 172 (single engine, four seats) and 32c/hr to a Cessna 310 (twin engine, multi-seat). In view of the fact that 8,198 general-aviation aircraft costing $182m were delivered to private and business owners in 1960 the Agency considers that this section of the community can well afford to pay a little more.

The proposals for raising revenue to pay for airways charges have provoked some strong words from the AOPA, which says "General aviation has no need for many of the costliest items in the system which are designed and operated for the benefit of airline traffic. General Aviation has no requirement for such exorbitant things as the Dulles International Airport, the Federally owned jet airport now being built near Washington DC, which is expected to cost about $175m when it is completed. Nor does it need the very costly all-IFR concept of the airlines that costs a fabulous amount of money to serve, and the exotic communications equipment that goes with such a system. The AOPA also expects to take a long hard look at such things as the duplicate services, exemplified by the costly ILS-GCA situation. AOPA has long contended that GCA serves everyone in the air equally while the ILS is essentially an airline requirement." To any pilot in Britain these must seem very heavy strictures to apply to an extra 1½d per gallon on petrol.

In conclusion, it may be added that the FAA's "Project Beacon," which has been accepted by the President, calls for an estimated $500m capital expenditure. Since this is exactly twice the cost of the current FAA five-year plan it seems almost inevitable that legislation will be introduced to recoup some of this money.

March of the Runways

AN INTRODUCTORY NOTE TO THE "FLIGHT" AIRPORT TABLES ON THE FOLLOWING PAGES

FOUR or five years ago the addition of an extra 1,000ft of runway length at any international airport would have been aviation news. Had it happened at London, two very eloquent camps would have sprung into existence overnight. One would have championed the necessity for providing extra take-off distance to enable Britain jealously to guard her hard-won aerial prestige; the other would have been equally vehement on the subject of squandering our priceless agricultural heritage simply to pander to the needs of monster aircraft that make our lives a misery with their fiendish noise.

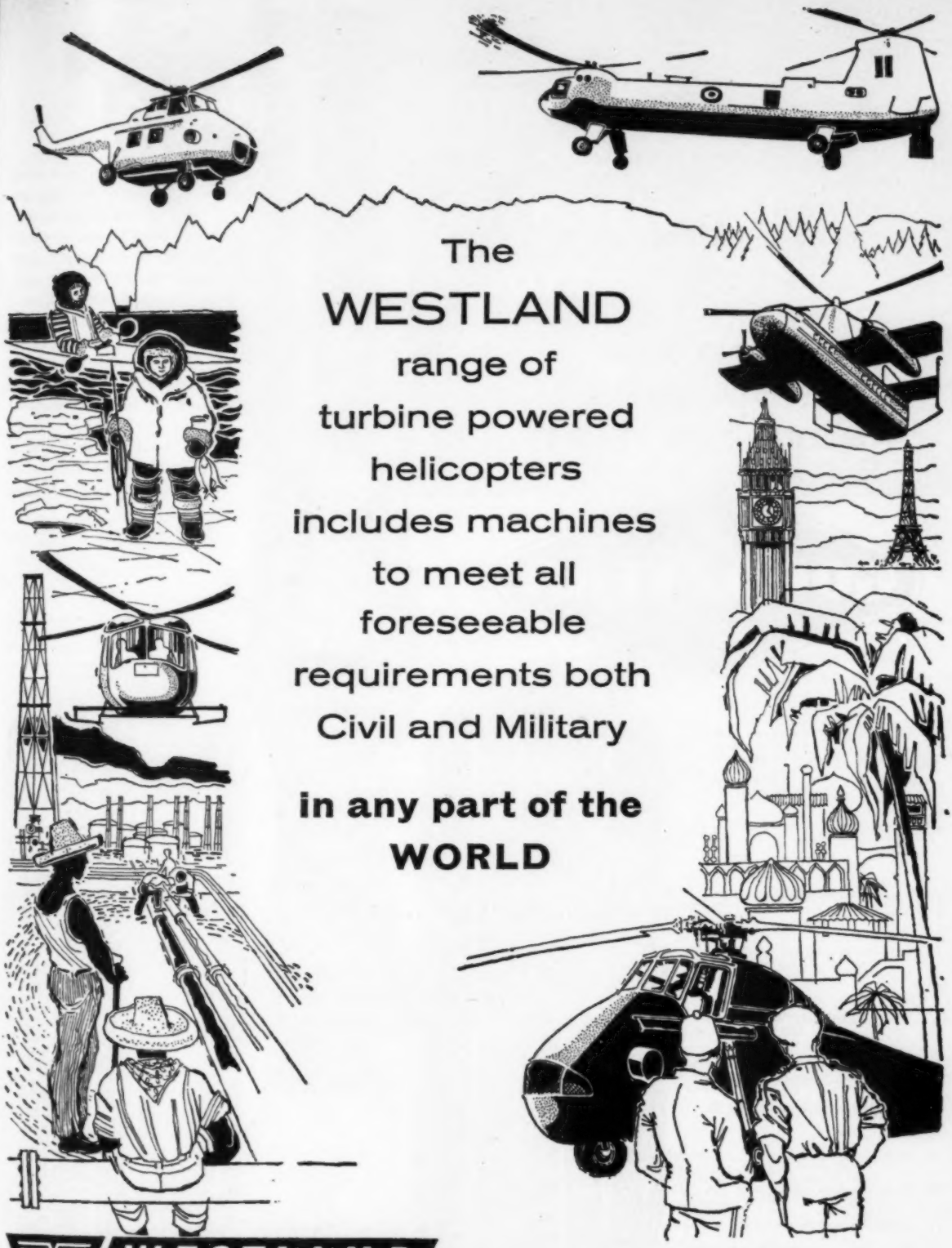
But that was half a decade ago; and the unusual of yesterday is the commonplace of today. In 1961 the addition of a mere 1,000ft to any runway hardly rates a mention.

The tables of airport data, which start on page 919, show that no fewer than five new runways of 10,000ft, or more, have been built during the past year. They are: Cologne, 12,460ft; Kandahar and Karachi, 10,500ft each; Shannon, 10,000ft; and Teheran, 13,123ft. Four runners-up have reached or exceeded the 9,000ft mark—Accra, Cleveland, Kabul and Tel Aviv. The tables also show that three brand-new airports (Cork, Jonköping and Kandahar) were opened during the year. Of course, these were not the only new airports to have been constructed during the twelve months, but the tables had to be restricted to a manageable size, and at the same time, within the space available, to be reasonably representative.

Although the rate of construction during the past twelve months has attracted relatively little attention it has in fact been at a much higher rate than ever before in peacetime. In the 1959 Airports Number of *Flight*, the analogy was put forward that the amount of reconstruction required to fit the world's major airports for the big jets was equivalent to an 80ft-wide main road stretching from London to Berwick-on-Tweed, a distance of 346 miles. During 1959, the programme had got under way very slowly and only about 21 miles were built. Pursuing the analogy, the 1960 figure was 49 miles, giving a total of 70 miles and putting the end of the road some seven or eight miles past Market Harborough. This year, with very little publicity, has seen the building of more runways and runway extensions than in the previous two years put together. No fewer than 83 miles more of our imaginary road have been built, so that it is now about five miles past East Retford, 153 miles up the route from London.

The present rate of progress looks as though it has sufficient impetus to carry it on through 1962 without a check. The new Washington/Dulles International is now scheduled to open in about six months from now, but whether or not it will be a success remains to be seen (the only certain thing is that several of the operators are agog with indifference at the thought of moving to it). Several other major projects are also in hand. New runways, of between 9,000ft and 10,000ft, are planned for Barranquilla, Delhi/Palam, La Paz/El Alto and Lisbon; and Santiago is due to have a completely new airport at Pudahuel. It had been expected that the new Magwa airport at Kuwait would have been opened by now, because it was certainly used during the recent military operations in that area. Rumour has it that a parade of tanks on a main runway is far more damaging to the surface than a flock of jet aircraft.

For years our astronomers have puzzled over the so-called canals on Mars. If there are any Martian observers left one wonders what they make of the ribbons of concrete and asphalt which are spreading so relentlessly over the face of this planet.



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International Airports

FACTS AND FIGURES

This is the fourth annual edition of "Flight's" tables of facts and figures about the world's international airports, over 250 of which are listed. Assistance by the staff of the Aeronautical Information Service of the Ministry of Aviation is gratefully acknowledged. The AIS have included the latest information available to them, correct to December 6.

Airport	Main runway: QFU, length × width (ft) and surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Abadan, Iran	14R/32L, 6,002 × 196, A 14L/32R, 7,094 × 115, A	176,000 a.u.w. (est) Not published	10	39.0 ART	New R/W available day only—no lights yet
Abidjan/Port Bouet, Fr W Africa	034/214, 8,856 × 164, T	Boeing 707, DC-8	20	29.2 ART	
Accra, Ghana	03/21, 9,600 × 200, T	LCN 65	221	29.3 ART	New R/W opened May 1961, 2,270ft longer than old R/W
Adelaide	04/22, 6,850 × 200, GL	LCN 45	12	24.4 ART	
Aden/Khormaksar	08/26, 8,386 × 150, A	LCN 50	10	32 est	
Algiers/Maison Blanche	06/24, 7,972 × 197, C	99,210 s.i.w.l.	82	28.2 ART	
Amman	06/24, 8,000 × 150, A	LCN 60	2,542	32 est	
Amsterdam/Schiphol	01/19, 9,563 × 197, A-C	148,812 s.i.w.l.	−13	17.8 ART	R/W lengthened by 1,197ft
Anchorage	06/24, 10,600 × 200, C	DC-7C	124	NA	R/W lengthened by 2,200ft
Ankara/Esenboga	03/21, 12,310 × 197, C	100,000 s.i.w.l.	3,096	21.5 est	R/W lengthened by 3,294ft and B/S raised from 200,000lb a.u.w.
Antigua/Coolidge Field, BWI	07/25, 6,300 × 150, C	160,000 a.u.w.	62	23 est	R/W lengthened by 500ft
Antofagasta/Cerro Moreno, Chile	18/36, 7,545 × 165, C	C-124	448	20 est	R/W lengthened by 820ft
Asuncion/President Stroessnar, Paraguay	02/20, 9,000 × 150, A	132,280 a.u.w.	301	21 est	
Athens	16/34, 8,333 × 197, A	100,000 s.i.w.l.	90	29 ART	Financial approval given Oct 1959 to extend R/W to 9,870ft. *Press report July 1960—R/W to be 10,500ft*
Atlanta, USA	09/27, 7,860 × 150 A-C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	1,024	21 est	
Auckland/Whenupai	04/22, 6,590 × 150, C	LCN 35	100	19.7 ART	
Baghdad	14/32, 7,054 × 150, T	231,000 a.u.w.	112	36 est	No information available on new planned airport notified in 1959
Bahrain/Muharraq	12/30, 7,500 × 200, T	55,000 s.i.w.l. at 114lb/sq in	6	34 est	
Baltimore/Friendship	10/28, 9,450 × 200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	146	24 est	No signs yet of new 10,000ft R/W for which work was reported approved in 1959
Bangkok/Don Muang	03/21, 9,840 × 197, C	Dry season 198,410 a.u.w. Wet Season 132,280 a.u.w.	12	35 est	
Barbados/Seawell	09/27, 8,000 × 150, A-C	Stratocruiser	165	28.3 ART	R/W lengthened by 1,000ft—due for further 1,000ft extension by end of 1961
Barcelona	07/25, 8,366 × 328, A	77,160 s.i.w.l. at 120lb/sq in	13	24.9 ART	
Barranquilla/Soledad, Colombia	03/21, 5,180 × 150, A	130,180 a.u.w.	47	23 est	New R/W 03/21, 9,514ft planned for third quarter of 1962
Basle/Mulhouse	16/34, 7,750 × 196, C	100,000 s.i.w.l.	882	21.5 ART	B/S reduced from 147,638lb s.i.w.l.
Basra	12/30, 6,000 × 150, A	132,800 a.u.w.	8	34 est	
Beirut	18/36, 10,662 × 200, C	148,812 s.i.w.l.	85	15† ART	
Belem/Val de Caes	06/24, 5,970 × 200, A	DC-7 max landing wt 109,000 and max t/o 114,112; also Caravelles	45	27 est	R/W 02/20 semi-permanently closed—06/24 due for extension to 8,248ft by end of 1961
Belfast/Nutts Corner	10/28, 6,014 × 150, C	LCN 40	359	16 ART	To be replaced by Aldergrove, in 1963?
Belgrade/Zemun	04/22, 5,249 × 262, C	44,090 s.i.w.l.	242	30 est	*A new airport for Belgrade is being built at SURCIN, R/W to be 9,840ft × 197ft*
Belize/Stanley Field, Br Hond.	07/25, 5,000 × 150, A	80,000 a.u.w.	16	25 est	*In a built-up area and unlikely to be developed*
Berlin/Tempelhof	09R/27L, 5,280 × 140, C	100,000 s.i.w.l.	163	20.6 ART	
Bermuda/Kindley Field	12/30, 9,710 × 150, A-C	250,000 a.u.w.	11	29 est	
Birmingham	16/34, 5,006 × 150, T	LCN 60	325	18 ART	LCN raised from 40 to 60
Biskra, Algeria	13/31, 9,711 × 148, A	44,090 s.i.w.l.	285	35.7 ART	R/W lengthened by 4,134ft

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, aerodrome reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for the hottest month of the year); est, estimated; NA, not available.

* Roman type in last column indicates official information and also relates to work done during the past year. Italic type indicates press reports unconfirmed from official sources.
† Official figure, but seems extremely low.

International Airports

FACTS AND FIGURES

Airport	Main runway: GFU, length × width (ft) and surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Bogota/El Dorado	12/30, 12,467 × 160, A-C	300,000 a.u.w.	8,355	14.8 est	
Bombay/Santa Cruz	09/27,10,500 × 150, C	60,000 s.i.w.l.	27	30.8 ART	
Bone/Les Salines, Algeria	01/19, 6,414, × 131, A	44,090 s.i.w.l.	10	28.2 ART	
Bordeaux/Merignac	05/23, 8,858 × 148, C	55,120 single wheel 72,750 twin wheel 154,320 bogie	161	21.9 ART	R/W lengthened by 1,968ft
Boston/Logan	04R/22L, 10,023 × 205, A-C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	19	22.5 est	
Brasilia, Brazil	10/28, 10,498 × 147, A	Boeing 707 t/o 261,284lb; landing 207,000lb	3,473	N.A.	R/W lengthened by 2,624ft
Brazzaville/Maya Maya, Congo (ex French)	06/24, 10,800 × 197, C	297,000 a.u.w.	1,044	27.3 ART	R/W lengthened by 3,255ft
Bremen	09/27, 6,262 × 160, C	59,520 s.i.w.l.	11	18.9 ART	B/S reduced from 88,500lb s.i.w.l.
Brindisi	14/32, 8,543 × 150, T	44,090 s.i.w.l., at 100lb/sq in	45	26 ART	
Brisbane/Eagle Farm	04/22, 7,760 × 200, C	LCN 60	7	26.7 ART	
Bristol/Lulsgate	10/28, 4,232 × 150, T	LCN unknown	611	17 ART	
Brno/Turany, Czechoslovakia	10/28, 6,560 × 196, C	39,000 s.i.w.l.	781	8.5 ART	B/S raised from 33,000lb s.i.w.l.
Brussels National	08L/26R, 11,942 × 148, C	110,230 s.i.w.l.	180	19.4 ART	Work in progress on R/W 08L/26R
Bucharest/Banesasa	07/25, 7,216 × 196, C	59,400 s.i.w.l.	297	25.2 ART	
Budapest/Ferihegy	13/31, 9,875 × 196, C	154,000 a.u.w.	440	20 est	
Buenos Aires/Ezeiza	10/28, 8,359 × 262, C-A	154,320 s.i.w.l., at 121lb/sq in	65	25 est	R/W being extended to 10,826ft
Cairo International	05/23, 10,826 × 197, C	74,960 s.i.w.l.	311	30.6 ART	
Calcutta/Dum Dum	01/19, 7,700 × 150, C	45,000 s.i.w.l., occasional 60,000	13	33.9 ART	*Extension planned to 10,500ft*
Calgary	16/34, 9,375 × 150, A	DC-6	3,557	NA	*Extension planned to 12,000ft*
Canberra	17/35, 6,800 × 150, GL	LCN 44	1,872	23.3 ART	
Canton	09/27, 6,000 × 150, C	150,000 a.u.w.	9	32 est	
Cape Town/D.F. Malan	01/19, 6,900 × 200, A	75,000 s.i.w.l.	151	22.3 ART	
Caracas/Maiquetia	08R/26L, 9,842 × 196, C-A	154,000 s.i.w.l.	230	25 est	R/W lengthened by 2,834ft
Cardiff/Rhoose	04/22, 4,534 × 150, T	LCN 25	220	18 ART	
Casablanca/Cazes	03/21, 6,003 × 148, C	114,640 a.u.w.	203	24.6 ART	
Chicago/O'Hare	14R/32L, 11,600 × 200, C	120,000 single wheel 200,000 twin wheel 375,000 twin tandem	667	24 est	
Ciudad Trujillo	16/34, 8,364 × 197, C	75,000 s.i.w.l.	57	24 est	Renamed "Santo Domingo"
Cleveland/Hopkins	05R/23L, 9,000 × 150, A	100,000 single wheel 175,000 twin wheel 310,000 twin tandem	789	23 est	New main R/W is 2,579ft longer than old R/W 18/36
Cocos	15/33, 8,000 × 150, Crl	LCN 45	11	28.3 ART	
Cologne/Bonn	14L/32R, 12,460 × 196, C	99,000 s.i.w.l.	300	19.4 ART	New R/W, 4,460ft longer than old R/W 07/25
Colombo/Katanayake	04/22, 6,000 × 300, C	LCN 60	28	29 est	LCN increased from 40. To be developed to international standards to 8,700ft
Colombo/Ratmalana	04/22, 6,013 × 150, A	30,000 s.i.w.l.	22	29 ART	
Copenhagen/Kastrup	04/22, 10,826 × 151/262, C	220,500 twin wheel 312,000 twin tandem	17	18.8 ART	
Cork	17/35, 6,000 × 150, C	50,000 s.i.w.l.	502	N.A.	Brought into service 16 October 1961
Curacao/Dr Albert Plesman	11/29, 11,500 × 200, A-C	In excess of LCN 100	26	25 est	R/W lengthened by 1,000ft
Dakar/Yoff	01/19, 9,512 × 148, C	Boeing 707, DC-8	56	28.6 ART	
Dallas/Love	13/31, 7,751 × 150, C	100,000 single wheel 150,000 twin wheel 330,000 twin tandem	485	24 est	
Damascus/Mezze	06/24, 8,235 × 197, A	44,090 s.i.w.l.	2,405	21 ART	*There is no news of the proposed new Damascus International Airport (which was to have been the first United Arab Republic development project). Meanwhile Syria has regained independence.*
Darwin	10/28, 9,570 × 200, C	LCN 90	86	31.1 ART	
Delhi/Palam	09/27, 7,500 × 150, T	17,000† a.u.w.	744	36 ART	New R/W of 10,500ft under construction
Denver/Stapleton	08R/26L, 10,010 × 150, A	120,000 single wheel 200,000 twin wheel 375,000 twin tandem	5,331	22.1 est	
Detroit/Metropolitan Wayne County	03L/21R, 10,500 × 200, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	639	20 est	
Dhahran	17/35, 10,000 × 200, A	300,000 a.u.w.	78	30.2 ART	Soon due for return to Saudi Arabian Government on expiry of USAF lease
Djakarta/Kemajoran	17/35, 8,120 × 197, A	60,000 s.i.w.l.	16	26.9 est	*New R/W planned, 12/30—10,800ft. Also planned, during eight year development scheme, to extend R/W 08/26 to 10,800ft*
Djibouti	09/27, 7,872 × 148, T	DC-7C	46	36.6 ART	
Dublin	06/24, 7,000 × 200, C	51,000 s.i.w.l.	222	19 est	R/W lengthened by 1,712ft
Durban/Louis Botha	05/23, 6,800 × 200, T	75,000 s.i.w.l.	25	25.2 ART	
Dusseldorf	06/24, 8,380 × 150, C	77,000 s.i.w.l.	133	19.7 ART	*Plans reported in 1959 for extending R/W to 12,800ft × 200ft*
Edinburgh/Turnhouse	13/31, 6,000 × 150, T	LCN 55	135	16 ART	LCN raised from 30
Edmonton / New International, Canada	01/19, 11,000 × 200, C	Unknown	2,373	15 est	
Elisabethville, Congo	075/255, 7,872 × 164, T	59,520 s.i.w.l.	4,185	25 ART	
El Paso	04/22, 11,000 × 150, A	90,000 single wheel 180,000 twin wheel 360,000 twin tandem	3,939	27.9 est	R/W lengthened by 1,957ft
Entebbe	12/30, 9,875 × 200, T	LCN 37	3,789	24 ART	
Fiji/Nadi	03/21, 10,500 × 150, C	LCN 70	63	28.1 ART	
Fort Lamy, Tchad	05/23, 9,184 × 131, T	154,000 a.u.w.	968	33.3 ART	R/W lengthened by 1,638ft
Forth Worth/Greater Fort Worth International	13/31, 8,450 × 200, C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	568	25 est	
Frankfurt/Main	07L/25R, 12,790 × 196, C	100,000 s.i.w.l.	368	20.9 ART	R/W lengthened by 980ft
Frobisher Bay	18/36, 9,000 × 200, A	DC-6 (?)	110	15 est	
Gander	14/32, 8,900 × 200, A	Boeing 707-120	496	17 est	R/W lengthened by 300ft
Geneva/Cointrin	05/23, 12,800 × 164, C	136,690 s.i.w.l.	1,410	20.6 ART	

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand: T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, aerodrome reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for the hottest month of the year); est, estimated; NA, not available.

* Roman type in last column indicates official information and also relates to work done during the past year. Italic type indicates press reports unconfirmed from official sources.
† Official figure, but seems extremely low.

BS
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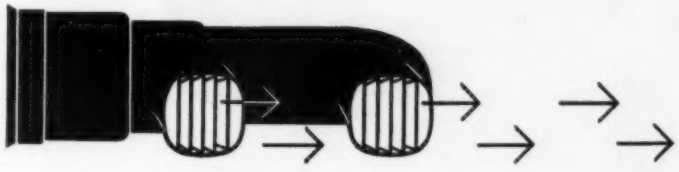
FOR V/STOL STRIKE AIRCRAFT



SIMPLIFIED POWER

Bristol Siddeley lift/thrust turbofans either permit the simplicity of a single-engine installation or reduce the complexity of a multi-engine installation for V/STOL aircraft. In both cases, Bristol Siddeley lift/thrust turbofans give important advantages.

SINGLE-ENGINE INSTALLATION

* The total installed power is available for both lift and thrust.
* Simplified installation.
* Simplified aircraft control.
* Maintenance and spares requirements are confined to one engine.
* Large power reserve available for acceleration and manoeuvre.

MULTI-ENGINE INSTALLATION

* Fewer specialised lift engines required as the total propulsive power is also available for take-off.
* Main engine rated to cruise requirements.

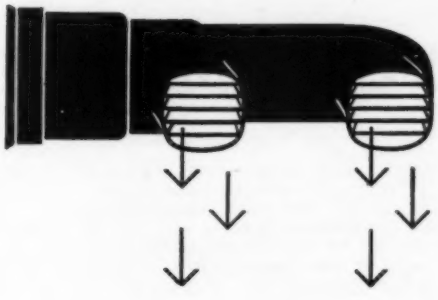
SUPERSONIC FLIGHT

In Bristol Siddeley lift/thrust turbofans fuel can be burned in the by-pass ducting or plenum chamber to give a thrust boost for take-off and supersonic flight. This plenum chamber burning permits:—

* A large thrust boost for supersonic speeds with only a modest increase in specific fuel consumption.
* Engine performance matched to aircraft cruise requirements.
* Greater thrust for transonic acceleration.
* Greater radius of operation.

These thrust boost advantages are achieved more economically by plenum chamber burning than by re-heat in the hot exhaust gases.

The development of Bristol Siddeley lift/thrust engines is supported by the US Government through the Mutual Weapons Development Programme.



BRISTOL SIDDELEY ENGINES LIMITED

★ Improved sensitivity, frequency response, distortion and power-handling capabilities with new type of telephone employing rocking armature principle.

★ Newly developed cellular ear pads in plastic material eliminate the disadvantages of liquid filled pads, and give the same or better attenuation characteristics.

★ Stronger boom arm in dull finished titanium eliminates unwanted reflections. The exclusive Airmed design has been retained allowing instantaneous adjustment of the boom in three planes without mechanical levers.

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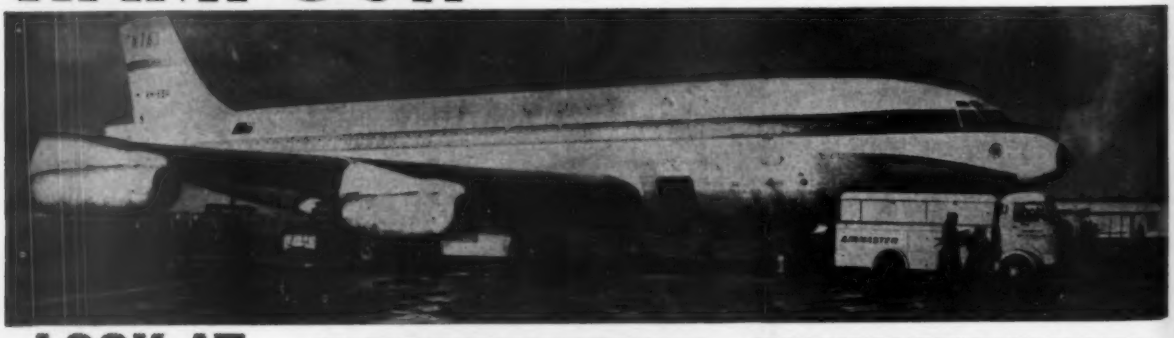

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HAMPSON

International Airports

FACTS AND FIGURES

Airport	Main runway: QFU, length × width (ft) and surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Georgetown / Atkinson Field, British Guiana	05/23, 7,430 × 250, C	200,000 a.u.w.	96	25 est	
Gibraltar	09/27, 6,000 × 150, A	60,000 s.i.w.l., at 100lb/sq in	15	24.4 est	
Glasgow/Renfrew	08/26, 5,789 × 150, T	LCN 35	42	16 ART	To be replaced by Abbotsinch—in 1963?
Goteburg/Torslanda	04/22, 5,970 × 196, A	44,090 s.i.w.l.	13	18.5 ART	*1960 press reports of proposals to extend two R/Ws to accommodate jets have not materialized yet*
Graz, Austria	17/35, 4,920 × 147, C	44,000 s.i.w.l.	1,110	20.3 ART	*Reported in 1960 R/W to be extended to 6,560ft*
Guam/Agana City	06L/24R, 10,000 × 150, C	100,000 single wheel 200,000 twin wheel 350,000 twin tandem	280	20.8 est	R/W lengthened by 2,000ft
Guatemala/La Aurora	01/19, 8,200 × 200, A	60,000 s.i.w.l.	4,952	20.8 est	R/W lengthened by 1,240ft
Guayaquil/Simon Bolivar	02/20, 8,000 × 150, A	DC-7	13	30 est	R/W lengthened by 1,970ft
Guernsey	10/28, 4,800 × 120, A	LCN unknown	336	18 ART	
Halifax, Nova Scotia	06/24, 8,800 × 200, A	Super Constellation	476	NA	
Hamburg	05/23, 10,000 × 150, C	60,000 s.i.w.l.	42	18.8 ART	R/W lengthened by 945ft. *Planned for extension to 11,800ft (1960 report)*
Hannover	10/28, 7,678 × 150, C	77,000 s.i.w.l.	179	19.2 ART	*1960 report said new R/Ws to be built*
Havana/Jose Marti	05/23, 10,500 × 150, A	C-124	208	25 est	R/W lengthened by 3,437ft
Helsinki	15/33, 7,381 × 196, A	LCN 45	167	18.5 ART	
Hong Kong International	13/31, 8,350 × 200, T	LCN 100	15	29.7 ART	New Terminal Building under construction
Honolulu International	08/26, 12,400 × 200, A	200,000 twin tandem	10	29.5 est	
Houston	03/21, 7,600 × 150, C	60,000 single wheel 90,000 twin wheel 200,000 twin tandem	50	26 est	
Innsbruck	08/26, 6,160 × 131, C	110,000 a.u.w.	1,906	20.1 ART	
Istanbul/Yesilkoy	06/24, 7,540 × 197, C	100,000 s.i.w.l.	88	28.9 ART	B/S raised from 200,000lb a.u.w.
Jeddah	09/27, 9,400 × 150, T	129,000 a.u.w.	50	31.3 est	
Jersey	09/27, 5,100 × 150, T	LCN unknown	276	18 ART	
Johannesburg/Jan Smuts	03/21, 14,500 × 200, T	135,000 s.i.w.l.	5,559	21.3 ART	
Jonkoping, Sweden	02/20, 5,250 × 150, A	44,092 s.i.w.l.	741	17.5 ART	New airfield, opened 31 January 1961
Kabul	11/29, 9,100 × ?, C	45,000 s.i.w.l.	5,795	NA	New R/W—replaces 4,700ft grass strip.
Kandahar	05/23, 10,500 × ?, A	45,000 s.i.w.l.	3,310	NA	New airport, opened 1 October 1961
Kano	07/25, 8,610 × 200, T	60,000 s.i.w.l. at 100lb/sq in	1,563	30.5 est	
Kansas City, Missouri	18/36, 7,000 × 150, C	110,000 single wheel 165,000 twin wheel 365,000 twin tandem	758	21 est	
Karachi	07L/25R, 10,500 × 150, C	LCN 83	75	31 ART	New R/W—replaces old 07/25 of 7,500ft
Keflavik	12/30, 10,015 × 200, A	63,000 s.i.w.l.	169	4.6 ART	Reykjavik is unsuitable for jets
Khartoum	18/36, 7,050 × 150, T	44,092, s.i.w.l.	1,253	32.6 est	
Kingston/Palisadoes, Jamaica	11/29, 7,600 × 150, A-C	155,000 tandem 300,000 twin tandem	10	29 ART	
Kiruna, Sweden	03/21, 5,570 × 147, A	44,000 s.i.w.l.	1,450	16.5 ART	
Kuala Lumpur	04/22, 6,200 × 150, T	LCN 40	111	28.8 ART	
Kuwait	14/32, 5,460 × 150, T	130,000 a.u.w.	20	38.2 est	Kuwait/Magwa (the new international airport, 7,200ft. B/S—Comet 4) not yet officially opened to civil traffic
Lagos	01/19, 7,600 × 150, T	51,000 s.i.w.l., at 100lb/sq in	132	28 est	
La Paz/El Alto	09/27, 11,087 × 394, GL	DC-7	13,398	18.6 est	New paved R/W of 10,800ft to be built—announced 1960 but no date given for starting work
Las Palmas, Canaries	03/21, 5,790 × 135, Hard soil	28,600 s.i.w.l., at 85lb/sq in	46	NA	
Leopoldville/Ndjili	07/25, 15,416 × 197, C	99,000 s.i.w.l.	1,014	27.6 ART	
Lima/Callao International	14/32, 11,482 × 147, A	Boeing 707 trans-continental at max: 77,160 s.i.w.l.	105	NA	
Lisbon/Portela	18/36, 7,874 × 147, C	77,160 s.i.w.l.	360	24 ART	R/W 18/36 has been lengthened by 1,313ft and replaces 04/22. New R/W under construction to be 12,662ft × 147ft
London/Gatwick	09/27, 7,000 × 150, C	LCN 75	194	18 ART	
London/Heathrow	10R/28L, 11,000 × 300, C	LCN 100	80	19 ART	R/W lengthened by 1,424ft, Oct 1961
Los Angeles	07R/25L, 12,000 × 200, A	150,000 single wheel 200,000 twin wheel 400,000 twin tandem	126	20 est	
Lusaka	08/26, 6,660 × 100, GL	LCN 50	4,208	27.6 ART	R/W has been widened by 30ft
Luxembourg	07/25, 9,284 × 197, A	220,500 a.u.w.	1,239	NA	
Madras	07/25, 6,000 × 150, T	30,000 s.i.w.l.	34	33.6 ART	R/Ws to be extended, no details available
Madrid/Barajas	15/33, 10,006 × 295, C	110,230 s.i.w.l., at 120lb/sq in	1,985	28 ART	R/W to be extended eventually to 13,450ft
Malmo/Bulltofta	06/24, 5,905 × 196, A	44,090 s.i.w.l.	16	18.5 ART	
Malta/Luqa	06/24, 7,800 × 150, T	LCN 60	297	27.5 ART	R/W lengthened by 1,800ft
Manchester	06/24, 7,500 × 150, A	LCN 65	256	17 ART	R/W lengthened by 500ft
Manila/Manila International	13/31, 7,954 × 100, A 06/24, 7,500 × 200, A	35,000 s.i.w.l. 75,000 s.i.w.l.	67	27.7 est	Work in progress extending R/W 24, originally planned for 10,000ft × 150ft (1960)
Maracaibo/Grano de Oro	04L/22R, 6,250 × 200, A	77,000 a.u.w.	131	25 est	
Marseille/Marignane	14L/32R, 8,858 × 148, C	66,140 s.i.w.l.	66	25.7 ART	
Melbourne	07/25, 6,100 × 200, GL	LCN 30	260	21.7 ART	*New airport planned at Tullamarine with N-S R/W of 10,000ft and NE-SW R/W of 8,000ft*
Memphis	09/27, 8,905 × 150, A	100,000 single wheel 200,000 twin wheel 400,000 twin tandem	291	NA	
Mexico City/Central	05R/23L, 11,700 × 149, A	Britannia 300	7,340	24.5 est	R/W lengthened by 1,860ft. *1960 report said airport to be enlarged, main R/W to be extended and high-intensity lighting and new surveillance radar to be installed*
Miami International	09L/27R, 10,500 × 200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	9	30.3 est	R/W lengthened by 1,100ft
Milan/Malpensa	17L/35R, 12,840 × 197, T-C	99,210 s.i.w.l. at 107lb/sq in	764	24.2 ART	
Mombasa/Port Reitz	09/27, 6,200 × 120, T	82,000 a.u.w.	186	30 ART	

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, aerodrome reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for the hottest month of the year); est, estimated; NA, not available.

* Roman type in last column indicates official information and also relates to work done during the past year. Italic type indicates press reports unconfirmed from official sources.
† Official figure, but seems extremely low.

Airport	Main runway: QFU, length × width (ft) and surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Montego Bay, Jamaica	06/24, 7,100 × 150, A	Stratocruiser	3	29 ART	
Montevideo	05/23, 7,052 × 147, A	Double - wheel gear: 141,100 a.u.w., at 100lb/sq in. Double wheel bogie: 277,600 a.u.w., at 100lb/sq in. Isolated operations up to 80% higher	75	18 ART	
Montreal/Dorval	06R/24L, 9,600 × 200, A	DC-8	117	22.7 est	
Moscow/Sheremetievo	07/25, 11,480 × 262, C	NA	623	23 est	Main airport for Moscow
Moscow/Vnukovo	02/20, 10,006 × 197, C	NA	669	23 est	Alternate for Sheremetievo
Munich/Riem	07/25, 8,530 × 197, C	99,200 s.i.w.l.	1,732	19.9 ART	*New R/W to be constructed (1960)*
Nairobi	06/24, 10,000 × 150, A	LCN 100	5,327	23.1 ART	Work in progress on extension planned to be 13,500ft
Naples/Capodichino	06/24, 7,218 × 197, T-C	61,500 s.i.w.l.	288	26.5 ART	B/S reduced from 77,160lb s.i.w.l.
Nassau	09/27, 8,529 × 150, A	Unlimited	10	29 ART	
Natal, Brazil	16/34, 7,380 × 200, A	DC-7 max landing wt 109,000, t/o 142,900. Boeing 707 t/o 276,000. DC-8 t/o 282,600	160	29.4 est	
Ndola, Northern Rhodesia	10/28, 6,650 × 100, GL	LCN 35	4,160	26.5 ART	R/W widened by 30ft
New Orleans/Moisant	10/28, 8,500 × 150, C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	3	28.3 est	R/W lengthened by 1,100ft
New York International/Idlewild	13R/31L, 14,600 × 150, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	12	23.9 est	
New York/La Guardia	13/31, 5,965 × 150, A	80,000 single wheel 105,000 twin wheel 105,000 twin tandem	20	23.9 est	R/W reduced by 50ft in width and lengthened 51 ft
New Jersey, Newark	04/22, 7,000 × 200, A	150,000 a.u.w.	18	23.9 est	
Niamey, Niger	09/27, 8,430 × 165, T	DC-8	732	36.9 ART	R/W shortened by 592ft. B/S raised from 265,000 a.u.w.
Nice/Cote d'Azur	05/23, 8,858 × 197, T-C	297,620 a.u.w.	13	23 ART	Runway lengthened by 1,640ft
Nicosia	14/32, 8,000 × 150, T	30,000 s.i.w.l.	728	27 ART	R/W 14/32 closed for 2-3 months from Nov 14 for re-surfacing. R/W 09/27, 6,000ft will be available in lieu
Okinawa/Naha	18/36, 8,000 × 150, A-C	DC-8	14	28.4 est	
Ontario, California	07/25, 8,200 × 150, C	50,000 single wheel 65,000 twin wheel 125,000 twin tandem	952	NA	
Oslo/Fornebu	01/19, 5,905 × 164, A	99,210 s.i.w.l., at 121lb/sq in	56	19.5 ART	R/W lengthened by 155ft. *Suggestion made in 1960 that Fornebu should serve as Norway's principal airport and that proposed new E-W R/W should be built as soon as possible, but nothing seems to have happened as yet*
Ottowa/Uplands	14/32, 8,800 × 200, A	Super Constellation	374	22.5 est	
Palma/Son San Juan	06/24, 7,874 × 196, A	59,520 s.i.w.l., at 100lb/sq in	9	25.8 ART	Now replaces Palma/San Bonet which is no longer available for civil use
Panama/Tocumen	03/21, 8,800 × 200, C	All types of jet	135	34 est	
Paramaribo/Zandery, Surinam	10/28, 9,842 × 150, C	300,000 a.u.w.	80	25 est	R/W shortened by 158ft
Paris/Le Bourget	07/25, 9,843 × 148, C	77,160 single wheel 88,180 twin wheel 154,320 bogie	217	22.1 ART	
Paris/Orly	08/26, 10,893 × 197, C	99,210 s.i.w.l.	292	21.5 ART	
Perth, Western Australia	06/24, 6,920 × 200, GL	LCN 24	51	25.4 ART	*Planned to extend R/W by 1,000ft in time for Olympic Games next year*
Philadelphia	09/27, 9,500 × 150, A	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	14	23 est	*1960 reports of new 11,000ft R/W have failed to materialize*
Pittsburgh/Greater Pittsburgh	10/28, 7,500 × 150, C	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	1,168	21 est	
Portland, USA	10/28, 8,800 × 200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	23	19 est	
Porto Alegre/Salgado Filho, Brazil	10/28, 6,560 × 137, C	Boeing 707-200,000 t/o and 175,000 landing. Caravelle t/o 96,000	9	24 est	R/W to be extended to 7,456ft during 1961 and further extended in 1962
Porto Santo, Madeira	01/19, 6,560 × 148, A-C	52,800 s.i.w.l.	305	23.7 ART	Inaugurated 28 August 1960 and officially opened 10 June 1961. R/W lengthened by 1,132ft. *Planned final length 11,500ft (?)*
Poznan/Lawica, Poland	11/29, 7,050 × 164, C	156,000 a.u.w.	295	NA	
Prague/Ruzyne	13/31, 8,595 × 148, C 04/22, 7,546 × 196, C-T (Instrument R/W)	50,710 s.i.w.l. 30,070 s.i.w.l.			R/W lengthened by 985ft. *Earlier press reports of building of new R/W of 10,407ft have not yet been fulfilled*
Prestwick	13/31, 9,800 × 150, C	LCN 80	64	16 ART	
Quebec/Ancienne Lorette	06/24, 6,000 × 150, A	DC-6B	239	20 est	
Quito/Mariscal Sucre, Ecuador	16/34, 10,234 × 150, A	DC-6B	9,220	N.A.	R/W lengthened by 1,214ft
Rangoon/Mingaladon	03/21, 8,100 × 200, C	150,000 a.u.w.	109	29.9 est	*Still no signs of 1958 plans to extend R/W to 10,200ft*
Recife	18/36, 7,800 × 200, A-C	Boeing 707-t/o 260,180. Landing 207,000	33	27.5 est	*Tentative plans for building extensions at each end of R/W 18/36*
Riazan, USSR	06/24, 8,202 × 262, C	NA	426	23 est	Alternate for Moscow
Riga, USSR	14/32, 5,577 × 164, C	NA	5	20.5 est	
Rio de Janeiro/Galeao	14/32, 10,827 × 200, C	Boeing 707, max t/o 286,000			
		No restrictions on other aircraft	10	25.2 est	R/W lengthened by 503ft

Airport	Main runway: QFU, length × width (ft) and surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Rome/Ciampino	16/34, 7,218 × 197, T	59,520 s.i.w.l., at 114lb/sq in	423	26.8 ART	Now available only to charter and military flights or as alternate for Fiumicino and for aircraft with damaged landing gear
Rome/Fiumicino	16/34, 12,795 × 196, C	99,210 s.i.w.l.	7	26 est	Main civil airport for Rome
Saigon/Tan Son Nhut	07/25, 6,560 × 132, T	45,000 e.s.i.w.l.	33	30.7 ART	B/S raised from 88,000lb a.u.w. *No sign of planned extension to 9,840ft (announced 1960)*
St Louis/Lambert	12/30, 10,018 × 200, C	160,000 single wheel 200,000 twin wheel 400,000 twin tandem	571	23 est	
Sal Island, Cap Verde	02/20, 6,560 × 164, A	99,210 s.i.w.l.	177	27.3 ART	
Salisbury	06/24, 8,612 × 150, C-GL	LCN 60	4,904	23.4 ART	
Salt Lake City	16R/34L, 10,000 × 150, A	120,000 single wheel 200,000 twin wheel 370,000 twin tandem	4,226	NA	R/W lengthened by 1,700ft.
San Diego/Lindbergh	09/27, 8,100 × 200, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	15	22 est	
San Francisco	10L/28R, 9,500 × 200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	10	15 est	
San Jose, Costa Rica	06/24, 6,600 × 150, C	C-118	3,020	NA	
San Juan/Puerto Rico International	07/25, 8,000 × 200, C	C-118	9	24 est	R/W lengthened by 200ft. Extensive work in progress on further extension. *Planned for 9,800ft (?)*
San Salvador, El Salvador	08/26, 5,250 × 150, A	C-54	2,044	NA	*Planned for reconstruction (?)*
Santa Maria, Azores	01/19, 10,000 × 196, A-C	77,160 s.i.w.l.	305	23.1 ART	
Santiago/Los Cerillos	03/21, 7,664 × 150, C	30,000 e.s.w.l. (but this has been grossly exceeded to detriment of R/W)	1,660	21.4 est	R/W lengthened by 1,089ft. New airfield, with 2 × 10,500ft R/Ws being built at Pudahuel, 10 miles outside Santiago
Sao Paulo/Congonhas	16R/34L, 6,190 × 160, C	Britannia 308, with landing and t/o restrictions	2,627	23.3 est	To continue in use for anything less than the bigger jet aircraft
Seattle/Tacoma	16/34, 9,800 × 150, C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	428	18 est	R/W shortened by 400ft.
Shannon	06/24, 10,000 × 150, C	70,000 s.i.w.l.	47	15.8 est	New R/W, 2,976ft longer than old R/W 05/23. B/S raised from 51,000lb s.i.w.l.
Singapore	02/20, 8,200 × 200, C	60,000 s.i.w.l., at 100lb/sq in	59	26.7 ART	
Southend	06/24, 5,265 × 120, T	LCN unknown	48	19 ART	
Stavanger/Sola	18/36, 8,366 × 246, C	99,210 s.i.w.l.	28	15.6 ART	
Stephenville	10/28, 10,000 × 200, A	B-377	86	NA	
Stockholm/Arlanda	01/19, 10,826 × 147, C	132,280 s.i.w.l.	111	19 ART	
Stockholm/Bromma	13/31, 6,223 × 196, A	33,069 s.i.w.l.	45	19 ART	Now available only for domestic traffic or as an alternate for Arlanda
Stuttgart	08/26, 8,366 × 164, C	77,000 s.i.w.l.	1,296	20.1 ART	R/W lengthened by 2,466ft. B/S raised from 59,500lb s.i.w.l.
Sydney/Kingsford Smith	06/24, 8,290 × 200, C	LCN 100	10	23.3 ART	*Four-year plan to bring airport up to jet standards, includes extending N/S R/W into Botany Bay to length of 7,500ft*
Sydney, Nova Scotia	07/25, 7,070 × 200, A	200,000 a.u.w.	202	22.9 est	
Tahiti/Faaa	04/22, 10,827 × 147, T	330,000 a.u.w.	6	28.5 ART	R/W has been lengthened by 4,595ft and is to be extended to a total of 11,480ft
Taipei	10/28, 8,544 × 200, C	90,000 s.i.w.l.	19	30.1 ART	R/W lengthened by 1,000ft. *Terminal facilities to be built*
Tamanrasset/Aguennar	03/21, 7,248 × 197, RS	NA	4,495	NA	
Tampa, Florida	18/36, 8,300 × 150, A	80,000 single wheel 120,000 twin wheel 270,000 twin tandem	27	23 est	
Tangier	08/26, 5,741 × 147, A	132,280 a.u.w.	46	24 est	
Tegucigalpa/Toncontin, Honduras	N/S, 5,900 × 150, A	DC-6	3,294	NA	
Teheran/Mehrabad	11/29, 13,123 × 196, ?	295,000 a.u.w. (?)	3,937	31.8 ART	New R/W, 3,283ft longer than old R/W 11/29. Lighting not yet installed
Tel Aviv/Lod	12/30, 9,944 × 150, A	LCN 90	132	32 ART	New R/W, 2,203ft longer than old 11/29
Titograd/Golubvci	36/18, 8,202 × 262, C	22,050 s.i.w.l.	101	NA	R/W widened by 112ft
Tokio	15/33, 8,400 × 148, A-C	63,000 s.i.w.l.	7	28.1 ART	*Reported new R/W of 10,000ft to be built parallel to existing R/W with completion date of 1962. Consideration will then be given to extending present R/W*
Toronto International (Malton)	14/32, 11,050 × 200, A-C	Super Constellation	569	20 est	*Under a ten-year $10m programme new 9,500ft R/W is under construction and the E-W R/W is to be extended to 12,500ft*
Toulouse/Blagnac	15/33, 8,202 × 197, T	220,500 a.u.w.	499	23 ART	
Trinidad/Piarco International ...	10/28, 9,500 × 150, A	65,000 s.i.w.l.	45	27 ART	R/W lengthened by 1,690ft
Turin/Caselle	36/18, 9,842 × 197, C	77,160 s.i.w.l.	986	17 ART	
Tunis/El Aouina	11/29, 6,003 × 151, T	39,680 s.i.w.l.	16	29 ART	
Turku, Finland	08/26, 5,905 × 197, A	154,320 a.u.w.	160	17.6 ART	
Valencia	12/30, 7,788 × 197, A	51,810 s.i.w.l. at 100lb/sq in	196	NA	
Vancouver	08/26, 10,600 × 200, C	75,000 s.i.w.l.	9	18 est	R/W lengthened by 2,000ft
Vienna/Schwechat	12/30, 9,842 × 197, C	38,500 s.i.w.l.	600	21.8 ART	
Viracopos/Campinas	14/32, 9,842 × 148, C	Boeing 707; DC-8 with t/o and landing weight restrictions	2,099	NA	R/W reduced by 788ft. (This airport was listed last year as Sao Paulo/Viracopos)
Wadi Halfa, Sudan	18/36, 6,000 × 150, GL	90,000 a.u.w.	509	33.3 est	
Wake	09/27, 9,900 × 150, A-C	200,000 twin wheel	14	28 est	R/W lengthened by 400ft
Warsaw/Okecie	15/33, 6,561 × 197, C	165,345 a.u.w.	345	17 est	*Reported R/Ws to be extended and new terminal building to be erected 1961-1965*
Washington, DC	18/36, 6,870 × 200, A	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	15	25.4 est	
Washington/Dulles International	18/36, 11,500 × 150 C	NA	NA	NA	New airport, now scheduled to open mid-1962
Winnipeg	13/31, 8,700 × 200, A	Super Constellation	785	21.7 est	
Zagreb/Pleso, Yugoslavia ...	05/23, 8,200 × 147, C	44,090 s.i.w.l.	351	20 est	*New concrete R/W under construction (?)*
Zaragoza, Spain	13/31, 12,140 × 196, C	77,845 s.i.w.l. at 185lb/sq in	833	NA	
Zürich/Zürich	16/34, 12,140 × 196, C	148,800 s.i.w.l.	1,414	22.2 ART	R/W lengthened by 3,610ft

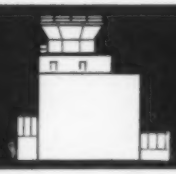
Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, aerodrome reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for the hottest month of the year); est, estimated; NA, not available.

* Roman type in last column indicates official information and also relates to work done during the past year. Italic type indicates press reports unconfirmed from official sources.
† Official figure, but seems extremely low.

Airport installations and equipment

A "FLIGHT" GUIDE TO REPRESENTATIVE BRITISH SERVICES AND PRODUCTS

PART ONE
FIXED INSTALLATIONS



Buildings and Runways

Building and runway construction contractors are listed as a section of the company addresses at the end of this review.

A structure which comes literally midway between airport buildings and their aprons, and which may conveniently be mentioned here rather than in the "Apron Equipment" section, is the Mercury Jetway passenger loading ramp, an American development for which **Mercury Airfield Equipment Ltd** have secured British Commonwealth and Middle East manufacturing rights. In effect, the Jetway ramp is a telescopic enclosed walkway providing direct access from the airport building to the aircraft passenger door, and it is arranged at the level of the latter so that no steps are needed. Two types are manufactured, one supported on rails at the side of the building and the other mounted on a wheeled leg running on the apron. The former type extends to 27ft and permits a door-height adjustment range through 4ft, while the latter extends to 107ft with height adjustment through 6ft 8in. Some 67 Jetways are in use at ten airports in the United States and a further 86 are on order for eight airports.

Not all airport buildings need be of a permanent nature, and temporary shelters of various sizes have been developed by the **Walter Kidde Co Ltd,** making use of a fabric-tube structure which derives rigidity by inflation to 100lb/sq in. BTR Industries are responsible for the tubular members, and fabric covers for the structures are supplied by a number of firms, including Frankenstein, Dunlop and R.F.D.

Kidde also supply the "Armadillo" semi-portable building; both this and the inflatable type were illustrated on page 352 of *Flight* for August 31.

Another manufacturer of portable buildings is **S. Grahame Ross Ltd,** the product combining the work of their engineering, joinery and canvas divisions.

Lighting

The **General Electric Co Ltd** supply almost every variety of airport lighting equipment, including complete systems. Recent introductions include v.g.p.i. units; high-intensity flush runway lights; quadruple obstruction lights; and taxiway flasher units which can be plugged in between the existing isolating transformer units and the lights to be flashed.

Joint development work by the RAE and **Thorn Electrical Industries** has resulted in the production by the latter of the RAE-Thorn visual glide-path indicator system, which will eventually be installed at all major British airports and which has also been approved by the Federal Aviation Agency for use on American airfields.

A complete system comprises, basically, two light-bars straddling the runway at the approach end. Each half-bar (i.e., on each side of the runway) consists of three units each containing three light-sources. A pilot on the approach sees the first bar as white and the second as red. If he is losing height too quickly the nearer bar will change to red; i.e., he will see two red bars. If he is too high the second bar will change from red to white, i.e., he will see two white bars. The change from red to white is gradual, there being a transition period of pink which gives warning of impending departure from the correct glide-path. In clear weather the signals can be picked up at ranges of from four to six miles by day and 15 miles or more by night.

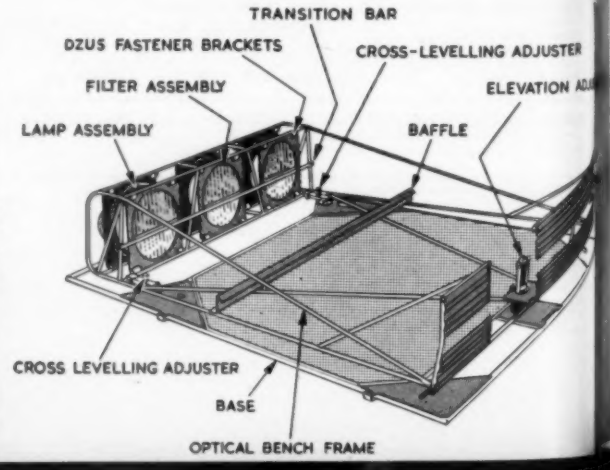
Sealed-beam lamp units for v.g.p.i. installations are made by **AEI Lamp & Lighting Co Ltd** and the **General Electric Co Ltd.**

Of approach lighting in general, AEI describe successful development of 200W sodium lamps which can be used as satisfactorily by night as by day. The sodium lamp has not been used in the past except in daylight, state AEI, because there has been no suitable method of adjusting brightness.

Harley Aircraft Landing Lamps manufacture a wide range of mobile lighting equipment, mainly of the self-generating type but also available with transformers for mains opera-

Right, interior arrangement of an RAE-Thorn v.g.p.i. light unit

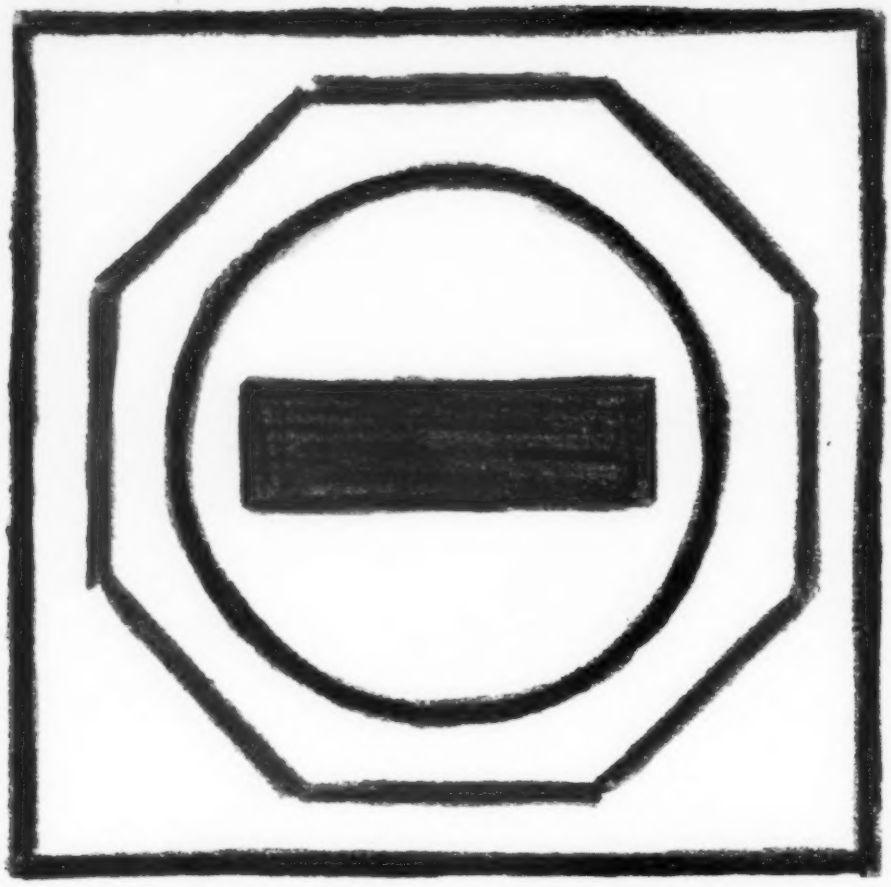
Apron-drive type of Jetway passenger finger (Mercury Airfield Equipment)



Landfall for Ulstermen

BEA have recently introduced Vickers Vanguards on their popular and important London-Belfast service. The Vanguard's 425 mph cruising speed and great passenger capacity reflect the trend towards large, economical aircraft on internal as well as international routes—a far-seeing development of the kind in which BEA is always well to the fore.
AIR BP are contracted to supply BEA's Vanguards at both airports.

Fast flying **BEA** ***...fast fuelling*** **AIR BP**



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ALLOY STEELMAKERS
FORGEMASTERS
STEEL FOUNDERS
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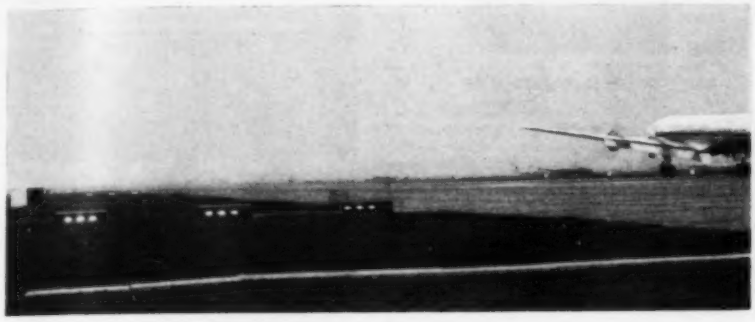
British Insulated Callender's Cables provided the current-collection equipment for the Esavian folding doors of the new extension of BEA's maintenance base at London Heathrow

AEI Lamp & Lighting Co Ltd supplied the lamps for the visual glide-path indicator at London Heathrow



tion. There are small box-type units that can be easily manhandled and carried in small vehicles; self-propelled units capable of being positioned under their own motive power; and trailer-type units for fast towing behind airfield vehicles.

Though developed primarily for Service use, the portable lighting equipment manufactured by **Butlers Ltd** should have a number of civil applications. The principal types are a marker light and a uni-directional runway light. Both are battery operated.

Revo Electric Co Ltd make a wide variety of airport lighting equipment, including blister-type runway lights with toughened-glass lenses designed to withstand a 1,500lb/sq in load; elevated taxiway and runway lights; obstruction lights; 140W sodium lamp units; floodlights for building illumination; sodium street-lighting lanterns, with low light cut-off for use on airfield approach roads; and a number of interior lighting fittings.

Airport lighting systems, both exterior and interior, imply the use of a great deal of cable, and in this connection **British Insulated Callender's Cables Ltd** are as well known as they are for their aircraft cables. In addition to lighting, of course, BICC supply cables for power and communication purposes. For BEA's recent £6m extension of their engineering base at London Airport, the company has provided 250 miles of various types of cable.

Alf'd Miles Ltd make non-corrodible light-alloy lighting columns in heights of from 15ft to 40ft.

Other firms concerned with airport lighting equipment include **Benjamin Electric Ltd, C.W.C. Equipment Ltd, Engineering & Lighting Equipment Co Ltd, Holophane Ltd, C. Maurice Contractors Ltd, Standard Telephones & Cables Ltd** and **Stone-Chance Ltd.**

PART TWO
RADAR, RADIO AND METEOROLOGY

Surveillance Radar

The latest in the series of general-purpose surveillance radars manufactured by **Cossor Radar & Electronics Ltd** is the S-band (10cm) Type C.R.787. Cossor claim that the 10cm band gives good vertical coverage without gaps, narrow beam-width with resultant high-definition display, and a reasonable aerial size and power consumption. Circular polarization can be introduced at will to eliminate rain echoes. The C.R.787 can be supplied in a trailer, or the weatherproof cabin and the aerial can be mounted on a tower or on the roof of a building. C.R.787 equipment is in service in Australia, New Zealand, Africa and Europe.

Cossor are further developing the CRD.23 advanced radar display systems, designed on the "building-block" principle. Information from CRDF and secondary radar is accepted and map displays from a twin video-mapping unit may be superimposed by interscan marking. Other features include four switched range-scales, up to ten aircraft identification and tracking symbols and facilities for target handover to parallel viewing units.

Mobile and static versions of the shorter-range CR.21 S-band surveillance radar are also available. Both the C.R.787 and C.R.21 may be combined with secondary radar.

Cossor have done pioneering work in the development of secondary radar for civil air traffic and a mobile version, the S.S.R.4G, is now operating at London Heathrow slaved to a Marconi S.14 radar, for some months. It includes sidelobe suppression, signals being transmitted and received at a 30ft beam aerial the rotation of which is slaved to that of the surveillance radar with which it is working. Range is 180 n.m. for aircraft flying at 30,000ft. Transmitter nominal frequency is 1,030Mc/s. Cossor are developing transponder equipment to conform with all the ICAO and Arinc characteristics.

Decca Radar Ltd have now supplied the D.A.S.R.1 S-band primary surveillance equipment for several airports. It gives gap-free coverage to ranges of over 100 n.m. at 37,500ft on a 10 sq m target. It features a back-to-back (cosec² and linear) aerial system, variable circular polarization to eliminate precipitation returns, and a form of permanent echo suppression known as Air Target Indication. Interscan displays permit superimposition of tracking and map information.

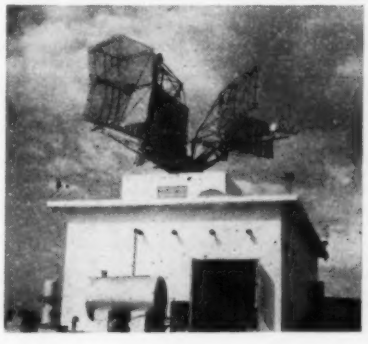
Decca have developed the transistor display system Mk 5 in which the circuits are maintained at constant temperature and humidity to give exceptional circuit stability and reliability. Size and power consumption are very considerably reduced.

Earlier Decca display systems already offered all the synthetic facilities such as videomap, rate-aided tracking, auto-follow and inter-console marking.

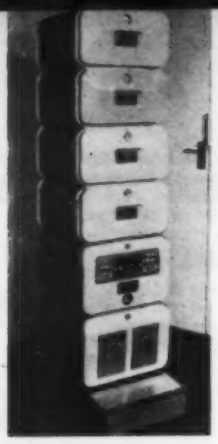
A great many orders have now been received for the Decca airfield control radar Type 424, a low-cost static, air-transportable or mobile landing aid which provides all-round surveillance for aircraft in the local area as well as precision azimuth information for step-down GCA. Variable polarization reduces precipitation echoes. The fully controllable display

Cossor CR 787 surveillance radar

Decca DASR I surveillance radar recently installed at Maiquetia Airport, Caracas



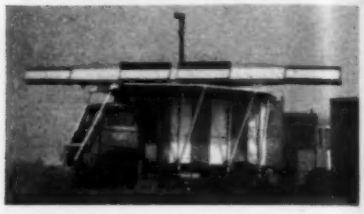
Decca displays at Schiphol, Amsterdam



Decca transistorized display drive equipment

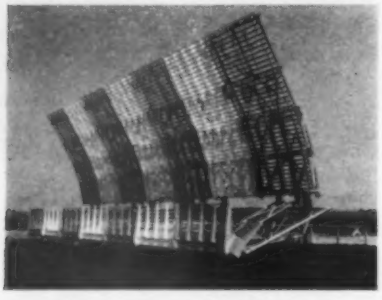
Marconi display suite, incorporating tabular unit and combined raw/synthetic radar unit

Cossor ground interrogator-responder for secondary surveillance radar at LAP



Decca HF.200 height-finding radar

Marconi 500kW 50cm radar Type S.264A/H at RNAS Yeovilton



incorporates range markers, bearing cursor and off-centre controls.

Decca also manufacture ASMI (airfield surface movement indicator) radar for controlling and observing movement on the ground in poor visibility. Range is eight miles, transmitting in Q-band at 15kW.

Marconi's Wireless Telegraph Co Ltd offer a wide range of high-performance radars in the 10, 25 and 50cm bands, each with its own advantages. In the 10cm (S-band) category, the Type S.306 offers good discrimination between close targets, freedom from siting difficulties, and unattended operation, with full remote control. A triple-pulse MTI permanent echo-cancellation system is fitted. The very high peak-power of 3MW is a feature of this equipment, which operates on frequencies between 2,700 and 3,300Mc/s.

For airports where the aerial must be mounted on the control tower, the Type S.263/1 is available in the 10cm range, with lightweight aerial capable of operation in wind speeds up to 70 m.p.h. Peak power is over 800kW; frequency 2,960-3,040Mc/s.

One of the latest Marconi long-range surveillance radars is the Type S.247, comprising two high-power (2½-3MW) transmitters, one at 10cm and one at 25cm, feeding a combined back-to-back aerial system. Together they give continuous cover on targets up to 75,000ft, with provision for MTI, remote control, etc.

Type S.255 utilizes the 25cm (L-band) system only, to give cover on small aircraft out to 200 miles. It is less affected by cloud and rain clutter than 10cm equipment, offers more efficient MTI characteristics and is capable of considerably better overall performance. Peak power is 2.5MW.

Marconi's 50cm radar sets combine all the features of the 10 and 25cm types, with outstanding reliability and freedom from the effects of weather and permanent echoes. The Type S.264A is a 500kW system developed from the equipment which has been used for some years at London Airport. The S.264A/H has a modified aerial providing increased vertical coverage at the expense of maximum range. Most recent of the series is the S.307, which possesses all the qualities of the S.264A but has improved definition and increased maximum range. All these radars are crystal-controlled and can be used simultaneously on long-range surveillance or close control of aircraft within the terminal area, using either fixed-coil or moving-coil PPI displays and video mapping if required.

Marconi announced this year their new SD.1015 display system, providing combined raw and synthetic displays, and the SD.1016 tabular display for panels of letters and figures.

Other Marconi radar sets range from the Type S.261 mobile 50cm radar to the 3cm SNW.40 series, which have a range of up to 45 n.m., with a peak power of 40-50kW and frequency of 9,360-9,460Mc/s.

A recent Marconi development is a parametric amplifier for use with the range of 50cm radars. It incorporates a fully coherent pump frequency which is crystal-locked to the radar and to a fully coherent MTI—the only one of its type in the world. The tube itself and its solenoid are manufactured by the **English Electric Valve Co.**

Aerial mountings and turning gear for surveillance radar are among the products of **John Curran Ltd.**

Height-finding Radar

From **Marconi** comes the Type S.239 800kW 10cm height-finder, designed to operate in conjunction with long-range surveillance radars and with an accuracy of ±500ft, at 50 n.m. Its parabolic reflector aerial "nods" to cover a vertical angle between −1° and +25° ten times per minute, and transmits on a fixed frequency in the 2,960-3,040Mc/s band. It is controlled from the elevation/scan display console.

The Type S.244 is more powerful, with an accuracy of ±1,700ft at 150 n.m. It has a peak output of 3MW in the 2,700-2,900Mc/s band and is capable of determining the absolute height of an aircraft above the ground or the relative heights of two aircraft. It can also operate as a volumetric radar, providing both height and plan position information.

Another highly-accurate long-range height-finder is the **Decca** HF.200. Like the Marconi S.244, this incorporates automatic limitation of the angle of nod when dealing with long-range targets, to avoid scanning useless airspace at high angles of elevation.

Precision Approach System

ILS is the main civil precision approach aid. Already in service for some time is the ILS manufactured by **Pye Telecommunications Ltd** and in worldwide service as a civil and military approach aid. It utilizes a uni-directional localizer and has full monitoring, self-correction and stand-by equipment in accordance with ICAO specifications.

Now standardized by five civil aviation authorities is the STAN 7/8/9 ILS with localizer, glide-slope and marker beacon transmitters, designed by **Standard Telephones and Cables Ltd** for the MoA. It includes directional and clearance localizer aerials, which reduce siting problems. Many components, including the fail-safe monitors, are transistorized and a mechanical modulation system gives greater stability and freedom from phase distortion. Both localizer and glide-path transmitters are fully monitored and automatic five-second change-over is provided between main and standby transmitters.

Now being used for automatic landing in the RAF, and possibly to be installed at London Airport for BEA, is Leader Cable, for which the airborne and ground-based units have been produced by **Murphy Radio Ltd.** The cables are laid parallel with the runway centreline extended some 5,000ft beyond the end of the runway.

In the Precision Approach Radar field, the SLA.3/B2, manufactured by **Standard Telephones and Cables Ltd,** provides the controller with three-dimensional information on approaching aircraft on twin azimuth/range and elevation/range cathode-ray tubes. Installations can be fixed or turntable-mounted to cover several runways. Airports at which SLA.3/B2 radar is in use include Hong Kong and Wellington, New Zealand, where the runways extend out to sea or are approached over difficult terrain.

Direction-finding and Beacon Equipment

Ekco Electronics Ltd offer at an exceptionally low price (approximately £2,000) the CE.178 CRDF equipment with a range of about 100 miles for an aircraft flying at 10,000ft, and radiating 5W. Bearing indication is given, with a maximum error of ±1.5° by a single radial line on a 6in cathode-ray tube, which can be positioned up to 2 n.m. from the 250 r.p.m. Adcock aerial. Frequency range is 100-156Mc/s.

Marconi produce a range of DF equipment. Types AD.210A and B provide visual, automatically sensed bearing indication on four channels simultaneously. They operate in the 100-156Mc/s band and can be integrated with ground-to-air communications schemes to provide combined DF and voice facilities. In addition, airfield control radar of suitable type can be fed with DF intelligence for identification purposes. Five crystal-controlled frequencies are provided for each channel. Type AD.210C is a simple low-cost single-channel model. In all cases the master and slave display units can be sited remotely.

Type AD.200 is a two-channel equipment operating in the 118-132Mc/s band, with local or remote (up to 30 miles) instantaneous presentation on an 8in diameter meter indicator. It is suitable for fixer or homer stations and

will provide VHF DF identification for airfield control radar. An automatic fixer equipment is available for use with the AD.200 and AD.210 series, giving direct presentation of an aircraft fix on a 17in cathode-ray tube, with a superimposed translucent map of the control area and controllable offset bearing-and-distance trace.

Marconi also produce the Type DFg26/4 HF DF equipment with twin channels and frequency range of 1.5-21Mc/s in four bands. Bearing presentation can be by spinning goniometer or cathode-ray oscilloscope. The Type DFg29 is a manually operated HF DF installation which can be mobile for rapid positioning and can operate where earth conductivity is so poor as to degrade the performance of an Adcock aerial.

Latest DF development from **Standard Telephones and Cables** is the long base-line Doppler direction finder using dipoles on a 12ft-long arm rotating at 180 r.p.m. This gives a true Doppler effect. The indicator is a new, accurate electromechanical device. Existing S.T.C. DF equipment includes the PQ range, which employ the latest commutated antenna techniques. CADF gives from five to ten times greater freedom from errors than does conventional DF. By electronic time-sharing, simultaneous presentation of DF bearings from two separate channels of equipment can be displayed on one Type A2208 cathode-ray indicator. For automatic position-fixing a number of DF stations can be linked to a control room where individual bearing lines are optically projected on a large map screen. A more recent development is the PVT.2, in which the bearings are optically projected from miniature CRDF displays and combined with map transparencies for presentation on a closed-circuit television system. A PVT.2 system combined with surveillance radar by inter-console marking, intended for identification of radar traces by VDF triangulation, was demonstrated at London Heathrow during the summer.

VOR ground beacons of Type BO.2 are also being produced by Standard Telephones and Cables. They meet ICAO standards. An important feature is the radically reduced cone of confusion achieved by the use of a wide-aperture aerial system. S.T.C. are also responsible for the STURN.3 and STURN.4 Tacan beacons and the STURN.5 DMET beacon, the last-named for use in conjunction with VOR. The STURN.5 incorporates self-monitoring and automatic change-over and has a range of 300 n.m. with 126 operating channels. Eleven VOR beacons produced by **Marconi** are now coming into operation on United Kingdom airways.

DME equipment available from **Murphy Radio Ltd** includes the Type RB110 transponder beacon which transmits at between 200Mc/s and 235Mc/s and can serve 75 aircraft simultaneously. It can be controlled remotely and automatic supervision can be provided by beacon control equipment MR255. Babs Mk4 is a beacon for use with Rebecca Mk 8 airborne equipment as a DME approach aid. MR347 is a mobile beacon for use with Rebecca.

Non-directional Beacons

Non-directional MF beacons for locator, homing and airways use available from **Marconi** include the Types WB8, AD501 and AD511 of 2.5-3.3kW, 250W and 20W power respectively. These have provision for CW, MCW and code-sending devices, and may be duplicated and fault monitored with automatic switchover.

Redifon Ltd manufacture a range of beacons which transmit at between 20W and 2.5kW on frequencies of 137-550kc/s, with CW/MCW. Some types incorporate RT facilities. A recent addition is a transistorized MF beacon designed for unattended operation. One of these has been installed on a rocky island on the west Greenland coast. Redifon also make the BCU.15 beacon control unit for monitoring and automatic changeover from main to standby transmitters. Other manufacturers of non-directional beacons include **General Electric** and **Standard Telephones and Cables.**

Weather and Wind-finding Radar

Marconi's Type SNW51 radar detects storms and rain-producing clouds over ranges up to 200 n.m., using a static or mobile aerial.

STC STAN 7 localizer, with clearance aerial in background

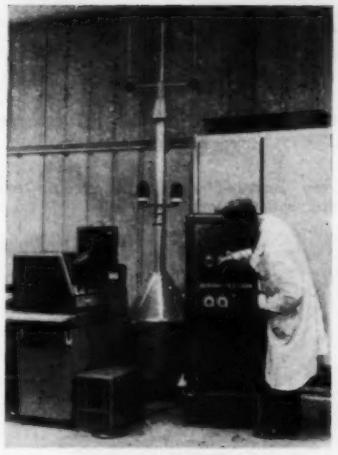
Right, STC Doppler D/F aerial assembly with radome partially in place

Peak power output is about 40kW, operating in the X-band (9,360-9,460Mc/s), with presentation on a moving-coil PPI.

Comparable equipment from **Decca Radar Ltd,** in world-wide use at airports, is weather radar Type 41 Mk IIA, a 25kW radar with a range of up to 220 n.m., in the X-band. The Type 42 has an improved gearbox and more powerful transmitter: Type 43 provides a range of height indicator in addition to the 12in PPI: Type 44 is an X-band unit for use where 3cm equipment is less effective. All these units can have the automatic plotting system providing a visual record of the PPI picture, called Radar Graph.

Wind velocities at heights up to 130,000ft and ranges up to 125 miles are given by **Cossor's** Type CR.353 10cm radar which works on the same principle. In its basic form it provides a display of range, bearing and elevation, but additional units can be supplied, such as PPI display, data recorder, teleprinter relay transmitter and a height and range resolver. The aerial can operate in winds of up to 100kt. Eight CR.353s were ordered for use in New Zealand and the southern Pacific Ocean.

The Decca WF 1 was the first accurate, economical, robust radar specially made for wind measurement by tracking passive balloons. The WF 2 is a completely self-contained development with a 2,5m parabolic dish aerial, and operator's cabin mounted on a tripod. It can be combined with the remote automatic data printer using an electric typewriter to record elapsed time, range, azimuth, and elevation detected in the WF 2.



Ekco CE.178 CRDF equipment on test

Meterological Equipment

A very full range of meteorological instruments is available from the old-established firm of **Negretti & Zambra Ltd.**

Short & Mason Ltd manufacture a range of apparatus among which are wind direction and speed indicators and a special aneroid barometer for airport control towers. The barometer is extremely sensitive to small pressure changes, is fully compensated for temperature and is mounted in a case, to match the remote-reading dials of the two electrical wind instruments.

R. W. Munro Ltd make various types of electrical wind speed and direction recording instruments, including types in which the cup-type anemometer is mounted directly above the direction vane, on the same mast. Portable instruments, for recording wind data in the vicinity of buildings, etc., are also manufactured.

The simple wind-sock still has its uses, and the **R.F.D. Co Ltd** are makers.

Airtech Ltd produce the cloud-base recorder, which, originally developed by the Meteorological Office, records continuously on a chart the height of the cloudbase, as derived by triangulation from a scanning transmitter using a modulated light beam. Reflection from the cloud is detected by a receiver unit 350ft from the transmitter, the angle of the light projector being sensed and fed with the received signal into the recorder. Cloudbases up to 4,000ft can be recorded. The three units are linked by land lines.

Murphy MR880 VHF R/T equipment, usually operated with MR820

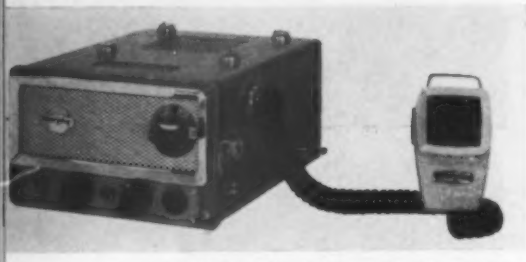
VHF Ground/Air Communications

A very wide range of VHF ground-to-air transmitters and receivers is offered by British manufacturers, including **British Communications Corporation, Ekco Electronics Ltd, Elliott Brothers (London) Ltd, General Electric Co Ltd, Marconi's Wireless Telegraph Co Ltd, Murphy Radio Ltd, Plessey Co Ltd, Pye Telecommunications Ltd, Redifon Ltd,** and **Stratton & Co Ltd.**

Many VHF radios are also produced for

Decca 41 Mk 11A weather radar at Jan Smuts Airport, Johannesburg

Creed Teletape receiver and (right), Sieger portable transistorized intercom set



Murphy M.R.820 VHF mobile R/T equipment

Creed Seventy-Five teletype receiver/transmitter with tape unit

Ten-line master unit of AEI intercom system in use at LAP

Creed Seventy-Five reproducer-terminal set

installation in airport vehicles. Others are designed to be carried by individuals in packs of various types.

W.S. Electronics Ltd are offering an airfield communications system based on a 90kc/s transmitter exciting loops surrounding the areas in which communications are required. Known as the D.126 communications system, this equipment is being supplied to the RAF, but is offered for civil use as well.

HF Communications

HF radio equipment for airport use is obtainable from **Airmec Ltd, General Electric Co Ltd, Marconi's Wireless Telegraph Co Ltd, Mullard Ltd, The Plessey Co Ltd, Pye Ltd, Racal Electronics Ltd, Redifon Ltd,** and **Standard Telephones and Cables Ltd.**

Message Recording and Transmission

Several companies manufacture equipment for continuous recording of RT traffic on tape. **The British Communications Corp** system may be one-, two- or three-bay, with each bay recording automatically up to 20 channels for eight hours and with self-monitoring.

The systems produced by **Simon Equipment Ltd** and **Thermionic Products Ltd** are self-monitoring, with automatic change-over from one tape to another. The Simon LDT 14 is based on four-channel six-hour units, with optional TIU-3 time-injector to superimpose timing signals directly on to the tape. The latest recorder from Thermionic Products is the Series III, based on a number of "building blocks" and incorporating transistors and printed circuitry. The first unit was installed in the Isle of Man early this year.

Creed & Co Ltd manufacture the Seventy-five teleprinter in which the typehead is movable instead of the paper unit. Many additional models are available from Creed, from **Standard Telephones and Cables,** with whom they are associated, and from **The Plessey Co.** The latter company also make the f.s.k. radio transmitters and receivers for teletype networks.

Racal Electronics offer a radio teleprinter HF receiver terminal in two forms, the RA.103 and RA.129. The units are suitable for f.s.k. working and can be extended from the 1-30Mc/s band to 12.5kc/s.

Redifon Facsimile Division offer the Redifax system using Alden facsimile for immediate transmission of large or small sheets of printed or written material to one or several remote points. Up to 300 sq in of material can be handled in one minute on a variety of sizes of machine. Telephone lines are used for transmission.

Closed-circuit visual and aural intercom over distances up to 1,200yd is provided by the Deccafax system produced by **Decca Radar Ltd.** Printed or handwritten material can be transmitted and modified, using 10in combined receiving and transmitting screens.

Creed offer the Teletape Transceiver for sending brief messages written on a tape. They also produce the Automatic Page Recorder for continuous reception of facsimile on a roll of paper, using Teledeltos paper.

Many companies produce industrial closed-circuit television equipment, which has obvious applications at airports. At London Airport two **Marconi** BD871 television cameras are installed on lighting standards to give the marshalling supervisor a view of distant parking areas. **Pye Telecommunications** offer a radio-directed television system in which the camera is controlled by a UHF radio link and the picture is transmitted to the receiving station over a microwave television link.

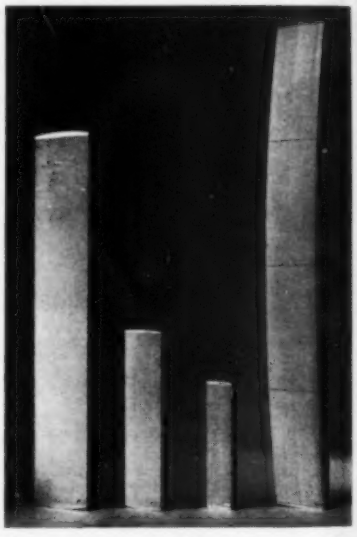
Though not basically electronic equipment, the document-transmitting system developed by **Dialled Despatches Ltd** may appropriately be included in this section. By its use, letters, documents and any article that will fit into carrying cylinders of 1.8in diameter (a 4.5in system is also available) can be sent through a plastic tube at speeds between 20 m.p.h. and 30 m.p.h. The carriers are "homed" to various receiving stations by an ingenious dialling system which positions appropriate diversion relays.

BEA have installed the system at Manchester, with a "ring main" covering ten such important stations as flight clearance, apron, engineering and emergency control points. Up to 45 stations can be served by an installation of this type.

AEI produce a transistorized intercom system for apron control and other airport use.

Sieger now make a portable, four-socket intercom set for use in high-noise surroundings or wherever additional headphone intercom is required. The unit is transistorized, uses small dry batteries, and may be held in the hand. Sales agents are **S & P Aeronautical Agents Ltd,** 64 George Street, London W1.

Burndept Ltd also make a portable intercom set of this type.



Westrex column loudspeakers for public-address systems

Public-Address Systems

Manufacturers of public-address systems suitable for airport use include **Associated Electrical Industries, Beme Telecommunications Ltd, General Electric Co Ltd, Goodmans Industries Ltd, Murphy Radio Ltd, Philips Electrical Ltd, Pye Telecommunications Ltd, Redifon Ltd, Standard Telephones and Cables Ltd, Tannoy Ltd, Trix Electronics Ltd, Ultra Electronics Ltd, W.S. Electronics Ltd, Whiteley Electrical Radio Co Ltd** and **Westrex Co Ltd.**

The range of equipment covers security and pageing systems for operational use as well as passenger address.

Control Consoles

In addition to the control desks for air traffic controllers available from equipment manufacturers, **International Aeradio Ltd,** can supply any type of console, of standard designs or specially tailored to meet individual requirements for traffic processing and communications. Makers of headsets include **Airmed Ltd, Amplivox Ltd** and **The Anticoustic Co.**

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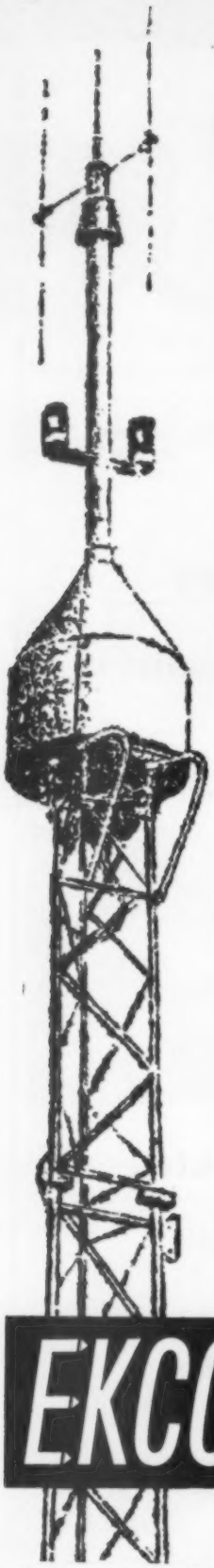
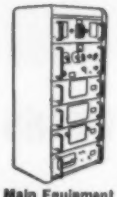


Efficient reliable AUTOMATIC VHF/DF

The new Ekco automatic V.H.F. direction-finding equipment gives cathode-ray tube presentation of the sensed bearing of a transmission on any one selected frequency in the 118-132 Mc/s band. (Special order 100-118 Mc/s: 132-156 Mc/s.) Facilities can be incorporated for operating simultaneously on two channels in the band using one aerial system. The equipment utilizes an entirely new method of deriving bearing and sense information from an Adcock aerial, permitting an installation of outstanding simplicity and reliability.

The equipment comprises



Main Equipment in a 4ft. rack

Indicator Unit which can be remotely located in Control Tower up to 4000 yds. distance.

Left: Adcock Aerial Unit with Sense Element.

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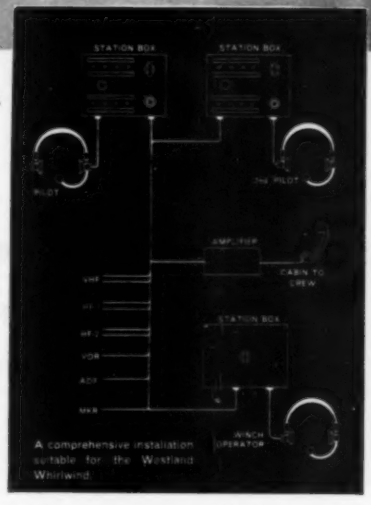
For Helicopters

ELLIOTT audio equipment

Photograph by courtesy of Westland Aircraft Ltd.



A comprehensive installation suitable for the Westland Whirlwind.

It goes without saying that any equipment for helicopters like the Westland Whirlwind Series 3 *must* be extremely light and compact.

This is where Elliott audio equipment scores. Without sacrificing reliability or quality of performance, its size and weight have been kept to the absolute minimum.

It will provide audio-integration, intercom or passenger-address—or any combination of these—to suit any aircraft and any individual requirements. Please write for leaflets which give full details.

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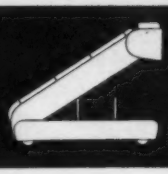
ARR3

PART THREE

APRON EQUIPMENT



Air Conditioning

For many years the **M.L. Aviation Co Ltd** have been associated with air-conditioning ground units, and typical of their range is the M.L. Coolair Mk 6. Claimed to be "the most efficient and fastest aircraft cooling unit available today," it delivers 2,500 cu ft/min against 16in w.g. pressure, with a maximum cooling capacity of 240,000 BThU/hr under ambient conditions of 110°F and 69 per cent RH. Power is provided by a Perkins industrial diesel which simultaneously drives the refrigeration compressor and the delivery fan. Automatic electrical control is provided. M.L. also produce pressure-testing equipment.

Another well-known maker of air-conditioning equipment is **Sir George Godfrey & Partners Ltd** who offer a trolley unit for cooling, heating and pressure testing. Trailer-mounted oil-fired pre-warming units for aircraft engines and cabins are one of the range of heating equipment made by **Dragonair Ltd.**

Blackburn Engines Ltd make an Artouste powered unit for air-conditioning and pressure testing and **Bell's Asbestos & Engineering Ltd** supply air-conditioning hose. **H.M.L. (Engineering) Ltd** have added a pressurization test trolley to their range of servicing equipment.

Some further firms making pressure test equipment are mentioned in Part 6.

Apron and Runway Cleaning

The ever-increasing use of jet aircraft has underlined the need for clean runways and taxiways if the risk of damage to engines is to be reduced, and several types of cleaning machine are now available for the purpose.

Lewin Road Sweepers Ltd manufacture a tractor-drawn sweeper/collector which sweeps in widths of 7ft 6in or, if used in gang formation and towed by the company's "Sweepmaster" sprinkler sweeper/collector, will sweep a 20ft width. The tractor-drawn unit has a 10 cu ft collector box and a 120gal water tank.

Lacre Ltd are responsible for the Bedford Lacre runway sweeper, a suction-sweeper vehicle designed to pick up both small and large debris. Hydraulic power is used for driving the brush, lifting the suction box from the operating position, and tipping the refuse container.

A smaller type of suction sweeper, principally for use in and around airport buildings rather than on aprons or runways, is the Verro Minor, made by **Alf'd Miles Ltd.** Propelled by a small petrol engine, it has two independently suspended hydraulically driven brushes.

Snow on runways, taxiways and aprons is not such a serious problem in this country as in, for example, Canada; but the occasional falls of an English winter can cause considerable inconvenience. **Mercury Airfield Equipment Ltd** are distributors of the Sicard SW-112 runway sweeper, which not only deals with snow and slush, but with runway debris in general. Towed by any small truck, state the makers, "at speeds as high as 25 m.p.h. it covers a mile of runway in less than three minutes, leaving behind it a sparkling clean 12ft wide strip."

A heavy-duty type of snow-clearing machine is the Rolba "Snowblast," designed for use with the Hough Payloader; **Rolba Ltd** are sole concessionaires. The snow is cut away by blades of helical design which carry it towards a high-speed impeller that throws it clear over a distance of up to 100ft; clearance capacity is about 800-1,000 tons per hour. From the same source there comes the still more powerful R.220A plough which can clear runways at a rate of up to 2,200 tons of snow per hour, ejecting it to a distance of about 150ft.

A type of runway obstruction more difficult to deal with than snow or debris, yet as dangerous to aircraft, is a flock of birds. **Trix Electronics Ltd**—a company of the Ultra Group—have been studying the bird-dispersal problem in collaboration with the MoA, and the conclusion has been reached that one of the most effective methods is to broadcast amplified tape-recordings of the alarm calls of birds common to the locality of the particular airfield.

Ground Power Units

Operators in search of ground power units have an extremely wide selection to choose from, mainly offered by firms who have specialized for many years in the manufacture of equipment of this type. Most of the units offered provide facilities for charging aircraft batteries and testing electrical services.

Among these firms is **Frederick Braby & Co Ltd,** who offer no fewer than 12 Auto Diesels models from a 24V lightweight battery starting unit to a 60kVA machine suitable for starting and servicing any type of aircraft; in addition they make a gas-turbine air starter.

Another extensive range of units, from 270A to 2,000A, is available from **Petbow Ltd,** and other well known firms who offer a selection of starting and test equipment include **Aircraft Ground Equipment Ltd, Houchin Ltd, Murex Welding Processes Ltd,** and **Red Devon Ltd.**

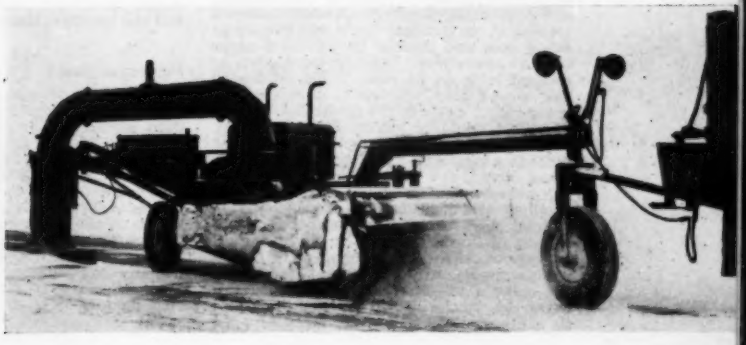
Among the more unorthodox types of GPU are the "Air Partner" marketed by **Atlas Copco (Great Britain) Ltd,** which utilizes the Lysholm type of rotary-screw compressor driven by petrol or diesel engine; and the steam starter (illustrated in this *Flight* review last year) developed by **Associated Electrical Industries Ltd,** which latter company also supplies a range of more orthodox motor generating sets. Another out-of-the-ordinary type of starting equipment is the Jetstart, by **I. V. Pressure Controllers Ltd,** which utilizes a battery of air bottles with special control equipment.

Blackburn Engines Ltd offer a starter and test trolley powered by the Artouste gas turbine, and the compact power units made by **Rover Gas Turbines Ltd** also find a use in this field.

Among firms supplying rectifier-type starting and servicing equipment, drawing power from the mains, are the **General Electric Co Ltd, Partridge, Wilson & Co Ltd, Standard Telephones & Cables Ltd,** and **Westinghouse Brake & Signal Co Ltd.**

Davenset rectifier ground-starting equipment, by Partridge, Wilson & Co

(Below, right) snow and slush clearance by a Sicard high-speed runway sweeper (Mercury Airfield Equipment Ltd). Below, Lewin sweeper collectors ganged to the "Sweepmaster"



Model of part of Short Bros & Harland's automated cargo-terminal project. A Belfast is shown taking on cargo from a power-operated pier

(Above) A Mercury Model 30P tractor in use at Zurich—one of the 114 Mercury vehicles operated by Swissair

(Left) Two "Wrigley" 30cwt airport luggage trailers by Wessex Industries (Poole) Ltd

(Right) "Hylo" loader by Aviation Traders (Engineering) Ltd

Cargo and Baggage Handling

Cargo handling is steadily, if slowly, moving towards planned automation, and **Short Bros & Harland Ltd** have completed an interesting study for a freight terminal that will make maximum use of the advantages offered by the two-deck, swing-nose civil version of the Belfast.

Freight arriving at the terminal by road is unloaded directly onto a powered roller conveyor system which carries it to loading piers or holding bays. *En route* it is automatically weighed on built-in weighbridges in the conveyors, then sorted, stacked and secured to pallets or in freight cages in readiness for loading into the aircraft. Turntables in the conveyor allow the direction of the palletized loads to be changed.

Power-operated loading piers travel on rails parallel to the front of the terminal. Each pier is some 90ft long, with a 25ft adjustable extension to permit latitude in positioning the aircraft, and has two decks, freight being carried to and from the upper deck by means of a lift installed in front of the receiving and dispatching platform. A loaded Belfast arriving at the terminal would simply open its swing nose and transfer its palletized cargo onto an empty pier. This pier would then be shunted aside on its rails, and a pre-loaded pier moved into position so that the outgoing cargo, again in the form of a "chain" of pallets, could be loaded into the aircraft. It is estimated that a complete loading and unloading operation could be carried out in about 30min.

Existing equipment in the cargo and baggage handling field includes devices ranging from hydraulically operated scissors-type high-loading platforms down to simple four-wheel baggage trucks for hand propulsion or towing behind tractors. **Aviation Traders (Engineering) Ltd** make a scissors-type loader which can either be tractor-hauled or self-propelled; six self-propelled versions are being supplied for use in conjunction with the Carvairs of Channel Air Bridge Ltd. **Mercury Truck & Tractor Co Ltd** make a three-ton high-loading truck elevating to 11ft 3in, and a completely new development by this company—in conjunction with **Fourways (Engineers) Ltd**—is a truck-mounted baggage-loading conveyor. Other manufacturers of high-loading equipment include **Access Equipment Ltd, Dennis Bros Ltd** and **F. L. Douglas (Equipment) Ltd. Rootes Motors Ltd** supply equipment of the high-lift type on Karrier and Commer vehicles. (Photographs: page 901)

Among specialized types of baggage-loading vehicle is the Cargomaster low-level loader manufactured by **F. L. Douglas (Equipment) Ltd.**

Wessex Industries (Poole) Ltd make numerous types of baggage trailer, and other manufacturers of trailers include **Edghill Equipment Ltd** and **Mercury Truck & Tractor Co Ltd.**

Two unorthodox approaches to cargo handling which merit mention in this section are the "Aircon" air transportable containers developed by **Airtech Ltd** and the collapsible-pallet system (enabling pallets to be easily removed from under the load in the aircraft hold) manufactured by **King Aircraft Corporation.**

Alf'd Miles Ltd have recently introduced a drop-side truck, primarily for use by building and runway contractors, but suitable for many apron duties; it is built on the standard Land-Rover short-wheelbase chassis, and the side and tail boards fold down independently.

Passenger Steps

Very completely equipped passenger steps are made by **Edghill Equipment Ltd** and have been supplied to a number of well-known operators. Known as the Autostair, this self-propelled equipment is hydraulically adjustable through a wide range and incorporates such refinements as flush lighting, destination boards and a shelter roof. Edghill also make a variety of simpler steps.

The Type 280 steps manufactured by **Mercury Airfield Equipment Ltd** are of particularly clean design, can be adjusted hydraulically from 6ft 6in to 12ft 3in, and have flush lighting.

The mobile stairs made by **C. F. Taylor (Metal Workers) Ltd** are in two models (11 and 15 treads) which can be elevated hydraulically to 10ft 5in and 11ft 6in respectively. Equipment includes illumination. (Illustration on facing page.)

Other manufacturers of airline passenger steps include **Heston Aircraft & Associated Engineers Ltd, Red Devon Ltd** and **Spurling Motor Bodies Ltd** (illustration below).

Toilet Servicing

Norstel & Templewood Hawksley Ltd now manufacture the range of toilet servicing equipment formerly made by A.S.T.; another manufacturer of such equipment is **Edghill Equipment Ltd**; and servicing hose is made by **Bell's Asbestos & Engineering Ltd.**

Passenger steps by Spurling Motor Bodies Ltd

David Brown 950 Taskmaster tractor on duty at Ringway, Manchester

Tractors

F. L. Douglas (Equipment) Ltd offer a wide range of tractors, including the Tugmaster Types 3022 and 3044, heavy-duty vehicles which have been developed specifically for handling the largest jet aircraft. The power-plant is a 240 h.p. diesel (Leyland, Cummins or Rolls-Royce) and automatic transmission comprises a torque converter and self-changing gearbox. Power-assisted steering is provided, with reversion to manual control available. These vehicles are so designed that they may be equipped with GPUs if required. A recent addition to the Douglas range is the N.S.6, a particularly compact vehicle with a tractive effort of 11,800lb and weight of up to 9½ tons.

Passenger steps, with canopy, by C. F. Taylor (Metal Workers) Ltd

Mercury Truck & Tractor Co Ltd manufacture "Air Tug" tractors of from 2,000lb to 20,000lb drawbar pull, which enables them to be used for a multiplicity of purposes from towing light servicing equipment to the largest jet aircraft.

David Brown Construction Equipment Ltd manufacture three types of aircraft towing tractor, all fitted with the 42.5 b.h.p. engine well tried in the company's agricultural tractors. The 950 Taskmaster develops a drawbar pull of 3,700lb and is suitable for towing aircraft of up to 45,000lb gross weight. The 960 Turbo Taskmaster has a Brockhouse turbo-transmitter (i.e., hydraulic torque converter) and a drawbar pull of 6,200lb; the smooth take-up of the torque converter enables this machine to handle aircraft weighing up to 110,000lb. Thirdly, there is the 950 Turbo Taskmaster Super, which has twin rear wheels and can tow aircraft of up to 150,000lb; power-assisted steering and braking are available.

Among other aircraft tractor manufacturers are **Lansing Bagnall Ltd.**

Tractors of the lighter type, for towing trolleys rather than aircraft are made by **Wessex Industries (Poole) Ltd** with petrol or battery power.

Fork-lift Trucks

Widely used in industry, the fork-lift truck has for many years been a useful tool for airport freight handling. These trucks are commonly used with a train of trailers which they have themselves loaded and which on reaching the aircraft are elevated one by one to the height of the cargo door.

Well-known manufacturers of fork-lift trucks include **Conveyancer Fork Trucks Ltd, Coventry Climax Engines Ltd, I.T.D. Ltd, Lansing Bagnall Ltd, Matbro Ltd, Ransome, Sims & Jeffries Ltd, Stockport Manufacturing Co Ltd,** and **Wessex Industries (Poole) Ltd.**

Defrosting Equipment

Defrosting of the surfaces of aircraft parked in the open in winter is a vital precaution. For reaching the highest components—e.g., tail units—the hydraulic platform made by **Simon Engineering (Midlands) Ltd** is employed by at least one operator; it gives a 40ft elevation and 26ft horizontal reach.

Trolley-type dispensers for defrosting are produced by **Rollason Aerocessories Ltd** and **Zwicky Ltd.**

De-icing fluids, including special hoar-frost removers, are supplied by **Kilfrost Ltd** [T.K.S. (Aircraft De-Icing) Ltd].

The Tugmaster DC7-Q—one of the powerful tractors from the F. L. Douglas (Equipment) range

Vehicles and Engines, Miscellaneous

Apart from the specialized types of vehicle dealt with in various sections of this review, a great many others, large and small, perform a variety of duties in and about airports, for the carriage of passengers, crews, officials, freight and equipment.

Most of the leading motor-vehicle manufacturers and suppliers, in conjunction with body-builders, cater for these requirements. In particular, mention may be made of **Rootes Motors Ltd, Scammell Lorries Ltd** (of the Leyland Group), **A.E.C. Ltd, Alvis Ltd, Dennis Bros Ltd, Transport Equipment (Thornycroft) Ltd, Ford Motor Co Ltd, Rover Co Ltd, Fodens Ltd, Spurling Motor Bodies Ltd, Palmer Coachbuilders Ltd,** and **R. J. Searle Ltd.**

Among manufacturers of engines are **A.E.C. Ltd, Coventry-Climax Engines Ltd, Leyland Motors Ltd** and **Rolls-Royce Ltd.**

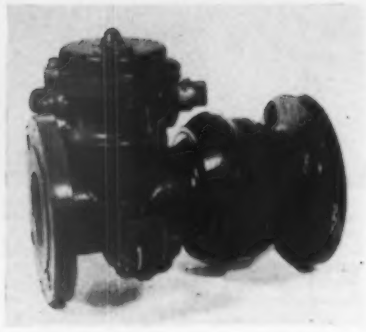
A Verheul-bodied A.E.C. "Regal" Mk IV operated by KLM for apron transport at Schiphol

Weighing Equipment

Certain of the well-known weighing machines made by **George Salter & Co Ltd** are particularly suitable for airport use—notably the Type 218 for passengers and the platform Type 113T for cargo.

General

In addition to the individual suppliers to whom reference is made in this section, **Aerocontacts (Ground Equipment) Ltd** offer an overall service through which an airport or airline operator can obtain all equipment required for apron, workshop or hangar use.



An emergency shut-down valve—one of the many refuelling components made by Flight Refuelling Ltd

Foden Python refuller for Esso: semi-trailer tank unit by the Steel Barrel Co Ltd

Fuellers

In general, the production of large refuelling vehicles is brought about by close collaboration between the fuel companies, suppliers of chassis, the firms who specialize in the supply of tanks, and the many others who provide control equipment, filters, fire protection systems, etc.

An example is seen in the Python refuellers used by Esso, which are of 60ft overall length and some 75 tons laden weight and carry 12,000 Imp gal of fuel. The Python is an articulated vehicle, comprising a **Foden** tractor and a semi-trailer tank unit—built by the **Steel Barrel Co Ltd**—supported on a twin rear axle by Carrimore Six Wheelers Ltd. The power unit is a **Rolls-Royce** diesel. The fueller is designed to dispense 1,000gal/min through two hoses and to defuel at approximately 150gal/min, the pumps, hose reels and other items being driven by hydraulic motors. Pressure control equipment is by **Zwicky**. Several of the firms mentioned under the "Refuelling Components" sub-heading on this page have supplied other items of equipment.

The **Leyland Motors** Group offers a wide range of chassis on which manufacturers of tanker equipment base their products. In the Leyland range are the Comet and Super Comet, Beaver and Super Beaver, Hippo and Super Hippo, and the Octopus; and available from Scammell Lorries Ltd are the Mountaineer chassis and the Constructor. From this range the group can offer vehicles with capacities ranging from 2,000 gal to 5,750 gal.

Saro (Anglesey) Ltd both design and manufacture tanks and tank trailers and they have supplied a number of vehicles of various capacities to Air BP, on chassis by **A.E.C. Ltd.**

Hydrant Fuelling

Well known for many years as manufacturers of fuelling equipment, **Zwicky Ltd** have lately been paying much attention to the increasingly popular hydrant systems and manufacture a range of dispensers.

Rellumit (London) Ltd are responsible for the 500gal/min "Ranger" dispenser, on a Karrier Gamecock chassis. It is equipped with two upper-deck hoses which can supply 250gal/min each and two reeled hoses supplying 200gal/min each. The hose-reels are hydraulically powered and the unit has very complete metering, control, filtration and fire protection equipment.

Other manufacturers of hydrant dispensers include **Truro Engine Works Ltd, Simmonds Aerocessories Ltd** and **Wayne Tank & Pump Co Ltd.**

Fuelling Components

Fuelling systems, whether tanker or hydrant, call for numerous specialized components. In the sphere of metering units and filtration well-known companies include **Avery-Hardoll Ltd, Automotive Products Co Ltd** (PurOlator), **Rellumit (London) Ltd, Simmonds Aerocessories Ltd, Stream-Line Filters Ltd, Tecalemit Ltd, Thompson Bros (Bilston) Ltd** and **Zwicky Ltd.** Specialists in metering equipment include **Wayne Tank & Pump Co Ltd, Firth Cleveland Instruments Ltd, Tecalemit** and **Thompson Bros.**

Most of the above-mentioned companies also supply valves and couplings, **Avery-Hardoll** in particular offering one of the widest ranges in this field, while **Flight Refuelling Ltd** have a wide range of valves and couplings, and **Lockheed-Avery** self-sealing couplings are also well known. **Armstrong Whitworth Equipment Ltd** have lately entered the field with a new range of coupling units.

Oil Dispensers

Lubricating-oil bowsers of various types, with metering equipment, are supplied by the **Steel Barrel Co. Ltd, Thompson Bros (Bilston) Ltd, Tecalemit Ltd, Truro Engine Works Ltd, Simmonds Aerocessories Ltd,** and other manufacturers.

Oxygen and Water/Methanol Replenishing Equipment

Oxygen breathing equipment to meet the MoA requirements for the provision of emergency oxygen for crews and passengers has been developed by **British Oxygen Aviation Services,** and all necessary equipment for the storage and dispensing of oxygen in liquid and gaseous form is available from the company. Lox dispensers of 75 and 185 litres are supplied on four-wheel-trolley mountings.

A simple but useful trolley for transporting oxygen bottles, with the necessary valving equipment, is now being manufactured by **Aviation Traders (Engineering) Ltd.**

Truro Engine Works Ltd make a variety of water/methanol dispensers; one example is the 120gal Medway, as supplied to Shell International.

Among other manufacturers of replenishing equipment apart from fuellers are **H. W. Edghill & Co Ltd, Mercury Airfield Equipment Ltd, Red Devon Ltd** and the **Steel Barrel Co Ltd.**

Suppliers of Fuels and Oils

Air BP (British Petroleum Co Ltd), BP House, Ropemaker Street, London EC2. T: National 1200.

Castrol Ltd, Castrol House, Marylebone Road, London NW1. T: Hunter 4455.

Duckham & Co Ltd, Alexander, Hammersmith, London W6. T: Fulham 3300.

Esso Petroleum Co Ltd, Aviation Dept, 50 Stratton Street, London W1. T: Hyde Park 7030.

Gulf Oil (Great Britain) Ltd, 6 Grosvenor Place, London SW1. T: Belgravia 5011.

Manchester Oil Refinery (Sales) Ltd, 76 Jermyn Street, London SW1. T: Whitehall 8411.

Mobil Oil Co Ltd, Caxton House, Westminster, London SW1. T: Whitehall 1010.

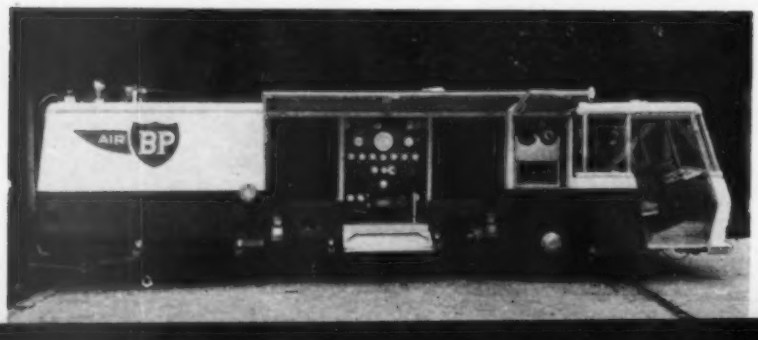
Ragosine Oil Co Ltd, Rocol House, Swillington, Leeds, Yorks. T: Garforth 2261.

Regent Oil Co Ltd, 117 Park Street, London W1. T: Mayfair 8474.

Royal Dutch/Shell Group of Companies, St Helen's Court, Great St Helen's, London EC3. T: Avenue 4321.

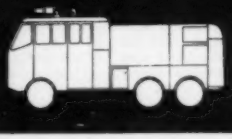
Shell-Mex & BP Ltd, Shell-Mex House, Strand, London WC2. T: Temple Bar 1234.

The Ranger hydrant refueller, manufactured by Rellumit (London) Ltd



Above, crash/fire tender by Fire Armour Ltd on Thornycroft Nubian chassis. Right, Pyrene-equipped Scammell vehicle in service with Shell of Venezuela. Lower right, light appliance by Alf'd Miles Ltd on a Land-Rover chassis

PART FIVE
EMERGENCY EQUIPMENT
(including Protective Clothing, etc.)



Crash/Fire Equipment

Well known for many years as manufacturers of fire-fighting equipment, **The Pyrene Co Ltd** have closely studied airport requirements. One of the largest and most powerful crash/fire tenders in their range is the Mk VI, on an Alvis Salamander 6 × 6 chassis powered by a Rolls-Royce B.81 engine. At the other end of the range are small tenders carrying foam and dry-chemical equipment, and there is also a range of extinguishers of hand and trolley-mounted types.

Fire Armour Ltd offer four basic types of appliance: Thornycroft Nubian, six-wheel drive, Rolls-Royce B.81 engine; Thornycroft four-wheel drive, Rolls-Royce B.80; Bedford R-type, four-wheel drive; and Land-Rover 109in-wheelbase chassis, four-wheel drive. These vehicles can be equipped to carry foam, CO_2 and dry chemicals in various combinations and quantities, and high-pressure pumps for "Waterfog," a finely divided spray, can also be fitted.

Scammell Lorries Ltd, a member of the Leyland Group, offer a fire-fighting vehicle based on their Constructor chassis. Powered by a 210 h.p. diesel engine, it incorporates two more diesels driving four fire pumps.

Alf'd Miles Ltd utilize the standard Land-Rover short-wheelbase four-wheel-drive chassis for their B-type appliance, equipped with a Coventry-Climax 300 gal/min pump, which can be remotely controlled.

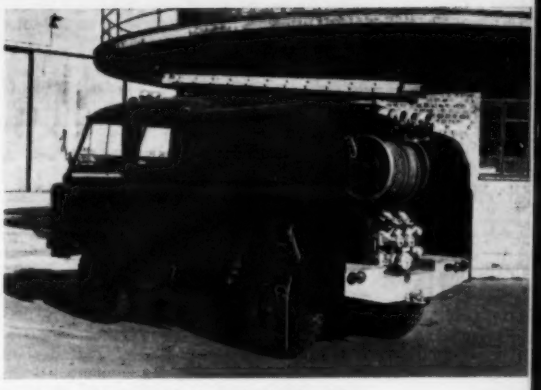
Other suppliers of complete appliances include **Dennis Bros Ltd, F. L. Douglas (Equipment) Ltd, General Fire Appliance Co Ltd, Merryweather & Sons Ltd, Sun Engineering (Richmond) Ltd,** and **Red Devon Ltd. R. J. Searle Ltd** supply Land-Rovers equipped for fire-fighting duties.

For airports with areas of water on or near their boundaries, the **R.F.D. Co Ltd** supply the Zodiac high-speed inflatable boat, which, carrying a fire-pump and crew, can quickly be towed on a trailer to a convenient point and launched; inflatable rafts can be carried to give additional rescue capacity.

The mobile floodlighting equipment made by **Harley Aircraft Landing Lamps** can provide valuable assistance at the scene of a crash after dark.

Runway Clearance

"Tracjacks" for the quick removal of crashed aircraft are made by **Skyhi Ltd,** and most of the manufacturers of cranes list models suitable for runway clearance; these include **Anderston Clyde Engineers Ltd, K. & L. Steelfounders & Engineers Ltd** (makers of the Jones cranes) and **Steel & Co Ltd** (Coles cranes). **John Curran Ltd** manufacture a 60-ton mobile crane specially designed for the salvage of aircraft in the 150-ton class, together with other items of clearance equipment. Another practical method of raising aircraft is the use of the pneumatic lifting bags made by the **R.F.D. Co Ltd.**



Apart from general-duty work, the Jones 10-10 crane is designed for aircraft salvage duties; used with sheer-legs and a special hoist block, it can lift a 45,000lb aircraft to enable bogies or a new undercarriage to be placed under it

Protective Clothing

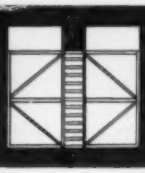
Makers of protective clothing—some of it for emergency use, some to give protection against deleterious industrial processes—include **Siebe, Gorman & Co Ltd, Baxter, Woodhouse & Taylor Ltd, Bell's Asbestos & Engineering Ltd** and **P. Frankenstein & Sons (Manchester) Ltd.**

The **R.F.D. Co Ltd** manufactures anti-kerosine clothing for refuelling crews.

Sonex ear defenders, giving an attentuation of 15-3db, are made by **Amplivox Ltd** and are in use at LAP and other airports. Headsets incorporating ear defender fittings are also part of the Amplivox range of this type of equipment. Other manufacturers of hearing-defence equipment include **Airmed Ltd, The Anti-coustic Co** and **Siebe, Gorman & Co Ltd.**

Breathing apparatus may fittingly be included in this section, and among its manufacturers are **Siebe, Gorman & Co Ltd** and **Normalair Ltd.** The **Walter Kidde Co Ltd** supply oxygen resuscitation sets.

PART SIX
MAINTENANCE EQUIPMENT



Access Equipment

Anderston Cyde Engineers Ltd make a variety of access equipment under the names "Move-on" and "Spaceman." The former are simple mobile platforms, in three models with maximum working heights of 4ft 6in, 16ft and 20ft, which the operator is able to propel by means of a handle on the platform. The latter, in four models giving maximum heights from 15ft to 34ft, is hydraulically operated (plus electrical power if required) and is of a particularly compact nature when in the retracted position.

Another well-known type of adjustable work-platform is the hydraulic "Giraffe," by **Access Equipment Ltd,** in models giving heights of up to 42ft; the same firm also offer the scissors-type "Safety Raiser," and "Zip-up" light-alloy staging, which can be erected to heights of 100ft or more without the use of bolts, nuts or assembly tools.

Mercury Airfield Equipment Ltd provide an electro-hydraulically operated equipment whereby up to three men can be elevated on a 6ft × 3ft platform through a height-range of 7ft 6in to 45ft. At heights below 20ft it will form a horizontal cantilevered platform reaching 20ft over an aircraft.

Other makers of adjustable platforms include **Thames Packaging Equipment Co, Murex Welding Processes Ltd** and **Simon Engineering (Midlands) Ltd.** Many operators assemble their own platforms and stagings from the well-known slotted angle material made by **Dexion Ltd.** Various types of maintenance steps are manufactured by **Aviation Traders (Engineering) Ltd.**

Cranes, Hoists and Jacks

Two manufacturers of cranes well known in the aviation industry are **K & L Steelfounders and Engineers Ltd,** makers of Jones Cranes (illustration, page 933) and **Steel & Co Ltd** (Coles cranes). **Anderston Clyde Engineers Ltd** make the versatile Colossus gantry, a mobile, self-erecting hoisting device, with manual or electrical operation. Standard capacities are 1 to 30 tons, though models of up to 100 tons can be supplied to order.

An ingenious type of hoist is the Minilift, made by the **Didsbury Engineering Co Ltd;** basically a hand-operated winding mechanism, it has a wide variety of ancillary attachments, including tubular cable-feeds which enable lifting operations to be conducted within aircraft interiors or other confined spaces. Capacities range from 2½cwt to 25cwt.

Skyhi Ltd manufacture a range of jacks with capacities of 2 to 80 tons, and they also supply wheel skates for the manœuvring of aircraft in confined spaces. **S. Grahame Ross Ltd** supply a variety of lifting equipment including wheel-change jacks and a heavy-duty jacking trestle operated by twin hydraulic jacks.

Engine Stands, etc

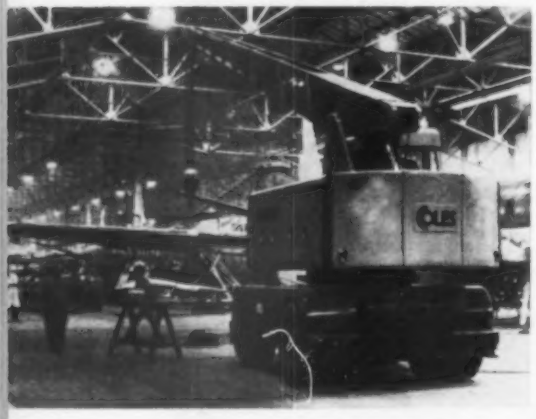
Murex Welding Processes Ltd supply various kinds of positioning equipment, from small bench models suitable for servicing electrical and lightweight assemblies to large positioners enabling major components to be set in any position required.

Frederick Braby & Co Ltd offer a range of engine-handling trolleys consisting of a positioning trolley, transportation and works stand, the powerplant being easily transferred on roller gear from one unit to another.

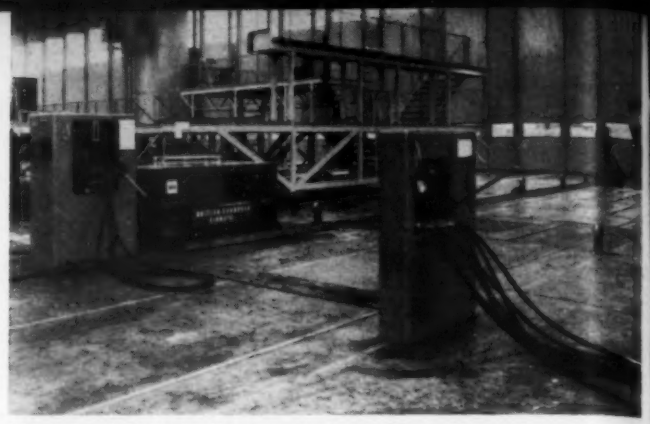
Engine and aircraft servicing equipment is a speciality of **Morfax Ltd,** who have given a great deal of attention to the production of equipment for specific types of engine—notably the Dart and Tyne—and aircraft. Items from their engine range include a hydraulically operated work platform for the stripping and assembly of large turbojets and turboprops in the vertical position; servicing, parking and road transport stands for gas turbines; and roll-over stands, including a model which permits the engine to be rotated in two planes.

Aviation Traders (Engineering) Ltd have a range of engine stands, slings and trolleys.

Coles cranes (Steel & Co Ltd) have been widely used for aircraft work for many years past



Anderston Clyde Colossus self-raising gantry



Okta "Ring Main" hydraulic test equipment, by H.M.L. (Engineering) Ltd, in use at BEA's engineering base

Test Equipment

Engine test plant of all kinds is manufactured by **Heenan & Froude Ltd,** and test stands for piston engines, turboprops and turbojets have been supplied to a numoer of airline operators by **John Curran Ltd.**

Most of the manufacturers of ground power units mentioned in the "Apron Equipment" section of this review supply similar machines for indoor testing of aircraft systems, and in this connection mention should also be made of **Associated Electrical Industries Ltd** (who also make an ignition tester for piston engines) and **Aircraft Ground Equipment,** whose AGE F.B.T. 30 feedback test-rig can test alternators of up to 90kVA with a prime mover of only 25 h.p. AGE also manufacture hydraulic test-rigs.

Hydraulic-system test-rigs are a speciality of **H.M.L. (Engineering) Ltd,** and their "ring-main" equipment illustrated on this page makes use of free-standing consoles which can be connected at any point in a fluid circuit powered by one of the company's Mk V mobile test trolleys as used for inter-flight servicing; or they can be used independently with hand-pumps. Other H.M.L. products include hydraulic-system test benches, and at the other end of the scale is their portable "Mini-Minirig," particularly suitable for testing helicopter hydraulic systems. Powered by a 1½ h.p. petrol engine or a 28V electric motor, it can supply 1gal/min at 1,200lb/sq in.

Automotive Products Co Ltd supply, through their associate Lockheed Precision Products Ltd, test-benches for the Lockheed hydraulic systems of such aircraft as the Comet 4.

Aero Electronics Ltd are sole export agents for Communications (Air) Ltd—a Cossor Group company—manufacturers of a wide range of electronic test equipment with many applications in the servicing of aircraft navaids and systems.

An unusual item of test equipment is the radiation monitor made by **Airmec Ltd** for the examination of aircraft that have passed through nuclear fall-out areas.

A simplified method of providing air and/or nitrogen over a wide pressure range for aircraft maintenance-shop test purposes is provided by the mobile air distribution panel made by **I.V. Pressure Controllers Ltd.** From **Normalair Ltd** comes lightweight pneumatic test equipment, and other test gear is made by **Bryans Aeroquipment Ltd** (particularly for the verification of aircraft instruments). **Racal Instruments Ltd, Graseby Instruments Ltd, Ultra Electronics Ltd, Cossor Radar and Electronics Ltd, Elliott Bros (London) Ltd, Armstrong Whitworth Equipment, English Electric Co Ltd, Goodman's Industries Ltd** and others.

Miscellaneous

Under this heading may be included the hydraulic clamping equipment developec by **S. Grahame Ross Ltd;** the "Leytool" ratchet spanners (and many other hand tools) made by **Leytonstone Jig and Tool Co Ltd;** the mobile workshops supplied by **Spurling Motor Bodies Ltd;** and the claim made by Aerocontacts (Ground Equipment) Ltd that they "can supply aircraft operators with anything from a screwdriver to a refueller."

Airmec radiation monitor with various types of probe used in conjunction with it

PART SEVEN
COMPANY ADDRESSES

A.E.C. Ltd, Windmill Lane, Southall, Middx. T: Southall 2300.
AEI Lamp & Lighting Co Ltd, 44 Fitzroy Road, London NW1. T: Primrose 7750.
Access Equipment Ltd, Maylands Avenue, Hemel Hempstead, Herts. T: Boxmoor 5781.
Aero Electronics Ltd, Gatwick House, Horley, Surrey. T: Horley 4455.
Aerocontacts (Ground Equipment) Ltd, Gatwick House, Horley, Surrey. T: Horley 4455.
Aircraft Ground Equipment Ltd, Blackswarth Road, Bristol 5. T: Bristol 58408.
Airmec Ltd, High Wycombe, Bucks. T: High Wycombe 2501.
Airmed Ltd, Harlow, Essex. T: Harlow 24331.
Airtech Ltd, Aylesbury and Thame Airport, Haddenham, Bucks. T: Haddenham 422.
Alvis Ltd, Holyhead Road, Coventry. T: Coventry 25501.
Amplivox Ltd, Beresford Avenue, Wembley, Middx. T: Wembley 8991.
Anderston Clyde Engineers Ltd, Irk Vale Works, Chadderton, Lancs. T: Main 7871.
Anticoustic Co, The, 7 Millmead, Guildford, Surrey. T: Guildford 66488.
Armstrong Whitworth Equipment, Hucclecote, Gloucester. T: Gloucester 66781.
Associated Electrical Industries Ltd, Rugby, Warwicks. T: Rugby 2121.
Atlas Copco (Great Britain) Ltd, Maylands Avenue, Hemel Hempstead, Herts. T: Boxmoor 6040.
Auto Diesels Ltd, Braby House, Smithfield Street, London EC1. T: Central 2388.
Automotive Products Co Ltd, Tachbrook Road, Leamington Spa, Warwicks. T: Leamington Spa 2700.
Avery-Hardoll Ltd, Oakcroft Road, Chessington, Surrey. T: Elmbridge 5221.
Aviation Traders (Engineering) Ltd, Southend Airport, Southend-on-Sea, Essex. T: Rochford 48561.
BTR Industries Ltd, Herga House, Vincent Square, London SW1. T: Victoria 3848.

Baxter, Woodhouse & Taylor Ltd, Woodside, Poynton, Cheshire. T: Poynton 2261.
Bell's Asbestos & Engineering Ltd, Bestobell Works, Slough, Bucks. T: Slough 23921.
Berne Telecommunications Ltd, 24 Upper Brook Street, London W1. T: Hyde Park 2291.
Benjamin Electric Ltd, The, Brantwood Road, Tottenham, London N17. T: Tottenham 5252.
Blackburn Engines Ltd, Brough, Yorks. T: Brough 121.
Braby & Co Ltd, Frederick, Smithfield Street, London EC1. T: Central 2388.
British Communications Corporation Ltd, High Wycombe, Bucks. T: High Wycombe 2501.
British Insulated Callender's Cables Ltd, Norfolk Street, London WC2. T: Temple Bar 7722.
British Oxygen Aviation Services, Pinnacle Works, Harlow, Essex. T: Harlow 26891.
Brown Construction Equipment Ltd, David, Meltham, Huddersfield, Yorks. T: Meltham 361.
Bryans Aeroquipment Ltd, 1 Willow Lane, Mitcham Junction, Surrey. T: Mitcham 5134.
Butlers Ltd, Atlantic Works, Grange Road, Small Heath, Birmingham 10. T: Victoria 3491.

C.W.C. Equipment Ltd, Kings Grove, Maidenhead, Berks. T: Maidenhead 2275.
Communications (Air) Ltd, Bagshot, Surrey. T: Bagshot 2521.
Conveyancer Fork Trucks Ltd, Liverpool Road, Warrington, Lancs. T: Warrington 35241.
Cossor Radar & Electronics Ltd, The Pinnacles, Elizabeth Way, Harlow, Essex. T: Harlow 26862.
Coventry Climax Engines Ltd, Widdrington Road, Coventry. T: Coventry 26481.
Creed & Co Ltd, Telegraph House, Croydon, Surrey. T: Municipal 2424.
Curran Ltd, John, Cardiff. T: Cardiff 20641.

Decca Radar Ltd, Decca House, 9 Albert Embankment, London SE11. T: Reliance 8111.
Dennis Bros Ltd, Guildford, Surrey. T: Guildford 5291.
Dexion Ltd, Maygrove Road, Kilburn, London NW6. T: Maida Vale 6031.
Dialled Despatches Ltd, Gosport, Hants. T: Gosport 80221.
Didsbury Engineering Co Ltd, Little Western Street, Rusholme, Manchester 14. T: Rusholme 1495.
Douglas (Equipment) Ltd, F. L., London Road, Cheltenham, Glos. T: Cheltenham 56946.
Dragonair Ltd, Fitzherbert Road, Farlington, Portsmouth, Hants. T: Cosham 76451.

Edghill Equipment Ltd, Odiham Road, Hook, Nr Basingstoke, Hants. T: Hook 40.
Ekco Electronics Ltd, Ekco Works, Southend-on-Sea, Essex. T: Southend 49491.
Elliott Bros (London) Ltd, Century Works, Lewisham, London SE13. T: Tideway 1271.
Engineering & Lighting Equipment Co Ltd, Sphere Works, Campfield Road, St Albans, Herts. T: St Albans 54524.
English Electric Co Ltd, Aircraft Equipment Division, Phoenix Works, Bradford, Yorks. T: Bradford 65221.
English Electric Valve Co Ltd, Waterhouse Lane, Chelmsford, Essex. T: Chelmsford 3491.

Fire Armour Ltd, 9 George Street, Baker Street, London W1. T: Welbeck 3313.
Firth Cleveland Instruments Ltd, 7 Cleveland Row, St James's, London SW1. T: Whitehall 3100.
Flexello Castors & Wheels Ltd, Slough, Bucks. T: 24121.
Flight Refuelling Ltd, Tarrant Rushton Airfield, Blandford, Dorset. T: Blandford 501.
Foamite Ltd, Clifton House, Euston Road, London NW1. T: Euston 5578.
Fodens Ltd, Elsworth Works, Sandbach, Cheshire. T: Sandbach 644.
Ford Motor Co Ltd, Dagenham, Essex. T: Dominion 3000.
Fourways (Engineers) Ltd, Thornwood Common, Epping, Essex. T: Epping 2251.
Frankenstein & Sons (Manchester) Ltd, P., Victoria Rubber Works, Newton Heath, Manchester 10. T: Failsworth 1166.

General Electric Co Ltd, Magnet House, Kingsway, London WC2. T: Temple Bar 8000.
General Fire Appliance Co Ltd, St Florian House, George Street, Croydon, Surrey. T: Croydon 2273.
Godfrey & Partners Ltd, Sir George, Hampton Road West, Hanworth, Middx. T: Feltham 3291.
Goodmans Industries Ltd, Axiom Works, Wembley, Middx. T: Wembley 1200.
Graseby Instruments Ltd, Kingston By-pass Road, Tolworth, Surrey. T: Elmbridge 5742.

H.M.L. (Engineering) Ltd, Harper's Yard, St John's Road, Isleworth, Middx. T: Isleworth 3011.
Harley Aircraft Landing Lamps, St Neots, Hunts. T: St Neots 230.
Heenan & Froude Ltd, Worcester Engineering Works, Worcester. T: Worcester 23461.
Heston Aircraft & Associated Engineers Ltd, Heston Airport, Hounslow, Middx. T: Hayes 3844.
Holophane Ltd, Elverton Street, London SW1. T: Victoria 8062.
Houchin Ltd, Garford Works, Chart Road, Ashford, Kent. T: Ashford 1701.

I.T.D. Ltd, Webb Lane, Hall Green, Birmingham 11. T:Springfield 2282.
I.V. Pressure Controllers Ltd, 683 London Road, Isleworth, Middx. T: Isleworth 7273.

AIRPORT BUILDING AND RUNWAY CONTRACTORS

Amey's Asphalt Co Ltd, Sutton Courtenay, Abingdon, Berks. T: Sutton Courtenay 275.
Constable Hart & Co Ltd, Lion House, Red Lion Street, Richmond, Surrey. T: Richmond 6044.
Costain Ltd, Richard, 111 Westminster Bridge Road, London, SE1. T: Waterloo 4977.
En-Tout-Cas Co Ltd, The, Syston, near Leicester. T: Syston 3322.
Gee Walker & Slater Ltd, 100 Park Lane, London, W1. T: Mayfair 7484.
Laing Construction Ltd, John, Page Street, London, NW7. T: Mill Hill 3636.
McAlpine & Sons Ltd, Sir Robert, 80 Park Lane, London, W1. T: Mayfair 8234.
Trentham Ltd, G. Percy, Pangbourne, Reading, Berks. T: Pangbourne 411.
Wimpey & Co Ltd, George, Hammersmith Grove, London, W6. T: Riverside 2000.

CONSULTANTS

Authorities and others contemplating the placing of contracts for airport construction commonly avail themselves of the expert knowledge of consulting engineers, architects and surveyors. For professional reasons such specialists are reluctant to have their names included in a review of this kind, but full details of the services they offer are obtainable from their professional associations, such as the Association of Consulting Engineers, Abbey House, 2 Victoria Street, London SW1 (telephone Abbey 6557) and the Association of Architects and Surveyors, 29 Belgrave Square, London SW1 (telephone Belgravia 3755).

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The Monospar referred to by the Hon Robin Cazalet in his letter below: a photograph taken at Croydon Airport in 1934

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Turboprop Beagles?

CLOSING-DOWN of the Christchurch factory of de Havilland and the threatened shut-down of the Gloster works with all its implications has no doubt come as a hard blow to readers of *Flight*. To my way of thinking this should be a challenge. Frankly, I see no reason why British designers should not recover our dwindling export trade in all classes of aircraft, though I have in mind the light and executive aeroplane that is now being sold from abroad through British agents.

Blackburn, de Havilland, Bristol Siddeley and Rolls-Royce could produce a medium-sized turboprop while the Rover concern is only waiting for a design in which to install its 90 h.p. turboprop. It is to be hoped that Beagle-Auster and Beagle-Miles will quickly market turboprop versions of all their products and I see no reason why existing Austers could not be modified to receive the 90 h.p. Rover turboprop—in the interim—to gain turboprop experience. If only we had another Claude Grahame-White to back Peter Masefield in his strenuous efforts to "wake up England"!

Birmingham 14 MAURICE AUSTIN

Rearward-facing Seats

REFERRING to recent correspondence about rearward-facing seats, I feel sorry for the ARB because, however well they present their case, they are not going to convince anybody who was unfortunate enough to read the remarks which triggered off the present discussion, and old friend Dick Abel (Correspondence, November 30) is not helping by throwing-in some irrelevancies.

Firstly, although some forward-facing people would doubtless be broken in half by their seat belts in a 9g crash, some other people would not. (For the sake of argument, a lady acrobatic dancer weighing 6½ stone probably wouldn't.)

Also, Dick Abel is criticizing forward-facing seats without referring to the method of holding down the passenger; and it may be that in a few years, when we are all used to wearing shoulder harness in our motor cars, airline commercial managers will not mind if passengers are told to strap themselves in properly for take-off and landing.

If this comes to pass, people will be able to survive more than 9g crashes without the discomfort of sitting in aft-facing seats during take-offs when the fuselage makes an angle which looks like 47½° to the horizontal, for reasons which have nothing to do with safety at all.

Sandhurst, Berks J. CUTLER

Monospar Memories

THE letter from Senrab (Correspondence, November 23) has caused me to scratch my head and look up some of my old albums.

As you say in a footnote to my previous letter (November 9) the original machine was built at Brockworth to the order of Aero Syndicate Ltd, Byron House, St James's Street. It was a three-seater and was designed to take two 80 h.p. Redrup engines. For some reason, these were not available, so it was fitted with two 40 h.p. Salmson engines, and taken to Hanworth in 1930 where it was put through flying tests.

G-ACHU was in fact built at Croydon, as Senrab says. I took it back there in February 1934 to have the ST.6 undercarriage fitted.

I have a photo [reproduced herewith—Ed] of what I think is the ST.10, taken that year, with the Airport Hotel clearly recognizable in the background. In the same year an ST.10 fitted with Niagara engines, G-ACTS, piloted by H. M. Schofield, with its designer as navigator, easily won the King's Cup race at a speed of 134 m.p.h.

I flew my machine in the same race and started favourite. For the first time in my life I took a navigator on board, but we lost the way on the Bristol leg.

In June the following year, General Aircraft gave a large party at their Feltham works to unveil the new "Jubilee" model S.T.25. This was similar to the ST.10, with two 90 h.p. Pobjoy Niagaras. It had a fifth seat at the back which could fold down to take luggage.

It had a Plessey radio receiver and homing device, cabin and navigation lights, and the specification included dipping landing lights, cabin starters, hydraulic wheel brakes with differential rudder control and parking brake, throw-over control wheel, upholstery by Rumbold, full tools and motor covers. The price all in, believe it or not, was £1,550.

K. Seth Smith spent all the afternoon taking parties joy-riding.

New Ross, Co Wexford ROBIN CAZALET

19th Century Speeds

I AM afraid that the Rev Alfred J. Bartlett's claim to be the holder of the world's speed record in 1893, with 40 m.p.h., is unacceptable. Perhaps you and your correspondent (this page, November 30) overlooked the fact that he claimed it "with a twinkle in his eye."

The Rev Bartlett, together with vast numbers of his contemporaries, habitually travelled at speeds much higher than 40 m.p.h., while many of their grandparents could have made a similar claim. When Whishaw published his train timings, taken in 1839 on normal services, maximum speeds of 50 m.p.h. were recorded on several railways, while down the Maddely Bank of the Grand Junction Railway the recorded maximum was 68.2 m.p.h. Even if we suspect that the crude methods of timing used inflated this last figure, it is reasonably certain that absolute maximum speeds of about 40 m.p.h. were reached soon after 1830, 60 m.p.h. about 1840, 80 m.p.h. early in the eighteen-fifties, and at least 90 m.p.h. in the early nineties.

And we must not forget the incredible speed achieved on the Dublin atmospheric railway in the early eighteen-forties. With a young engineering student aboard, the towing carriage broke away from the rest of the train and ascended this short, steep and bumpy line at a speed alleged to *average* over 90 m.p.h. A few simple calculations seem to show that this speed was quite possible, and that the acceleration experienced could have been little inferior to that given by a modern steam catapult!

Although motor cars had not attained 40 m.p.h. by 1893, I think that we can dispose of any claims made after 1837 for world land speed records as low as 40 m.p.h.

Yeovil, Som M. C. JONES

Mixed Ornithology?

SURELY the caption to your photograph on page 857 (issue of November 30) should say that the Wakefield seaplane *is* the *Waterhen*. Cowley points out that Waterbird was destroyed in March 1912. Your photograph was published in June.

Is your ornithology getting a trifle mixed?

London W1 F. H. SMITH

FORTHCOMING EVENTS

Dec 15 RAeS Man-powered Aircraft Group: "Problems of a Man-powered Rotorcraft," by R. A. Graves.
Dec 17 Institute of the Aeronautical Sciences: Wright Brothers Lecture, Washington DC.
Dec 18 Institute of Transport: Annual General Meeting.
Dec 19 Photogrammetric Society: "Adjustment of Aerial Triangulation by Electronic Digital Computers," by D. W. Proctor and Faud Amer.
Dec 19 Institute of Transport (West Middlesex Group): "Practical Aspects of Operating Jet Aircraft," by Capt J. B. Linton.
Dec 21 Society of Instrument Technology (Grangemouth Section): "Instrumentation of Space Vehicles," by Dr A. E. Roy.
Jan 1 Institute of Transport (Metropolitan Section): "Development of an Airport," by Maurice G. Housego.
Jan 4 RAeS: Young People's Lecture, "Airliners of the Future," by Godfrey H. Lee.
Jan 5 RAeS Rotorcraft Section: "Rotating Aerofoils and Flaps," by Dr S. Neumark.
Jan 10 Guild of Air Pilots and Air Navigators: Livery Dinner.
Jan 15 RAeS Historical Group: "R.101 and Other Airships," by Sir Harold Roxbee Cox.
Jan 16 RAeS Astronautics and Guided Flight Section: "Development of Seaslug," by C. Bayly and A. Lightbody.
Jan 20 Aircraft Recognition Society: All-England Competition.
Jan 24 RAeS Graduates' and Students' Section: "The New Bluebird," by K. W. Norris.
Jan 26 RAeS Man-powered Aircraft Group: "Design Philosophy of Man-powered Aircraft," by J. J. Spillman.
Jan 29 RAeS: Joint discussion with Institution of Electrical Engineers.
Jan 30 Institute of Transport (West Middlesex Group): "The work of IATA and the Clearing House," by A. J. Quin-Harkin.

RAeS Branch Fixtures (to Dec 21): Dec 15, Weybridge, Annual Dance. Dec 19, Glasgow, "The Place of Wind Tunnel Research in the Development of a New Aeroplane," by K. B. J. G. Asbeek Brusse.

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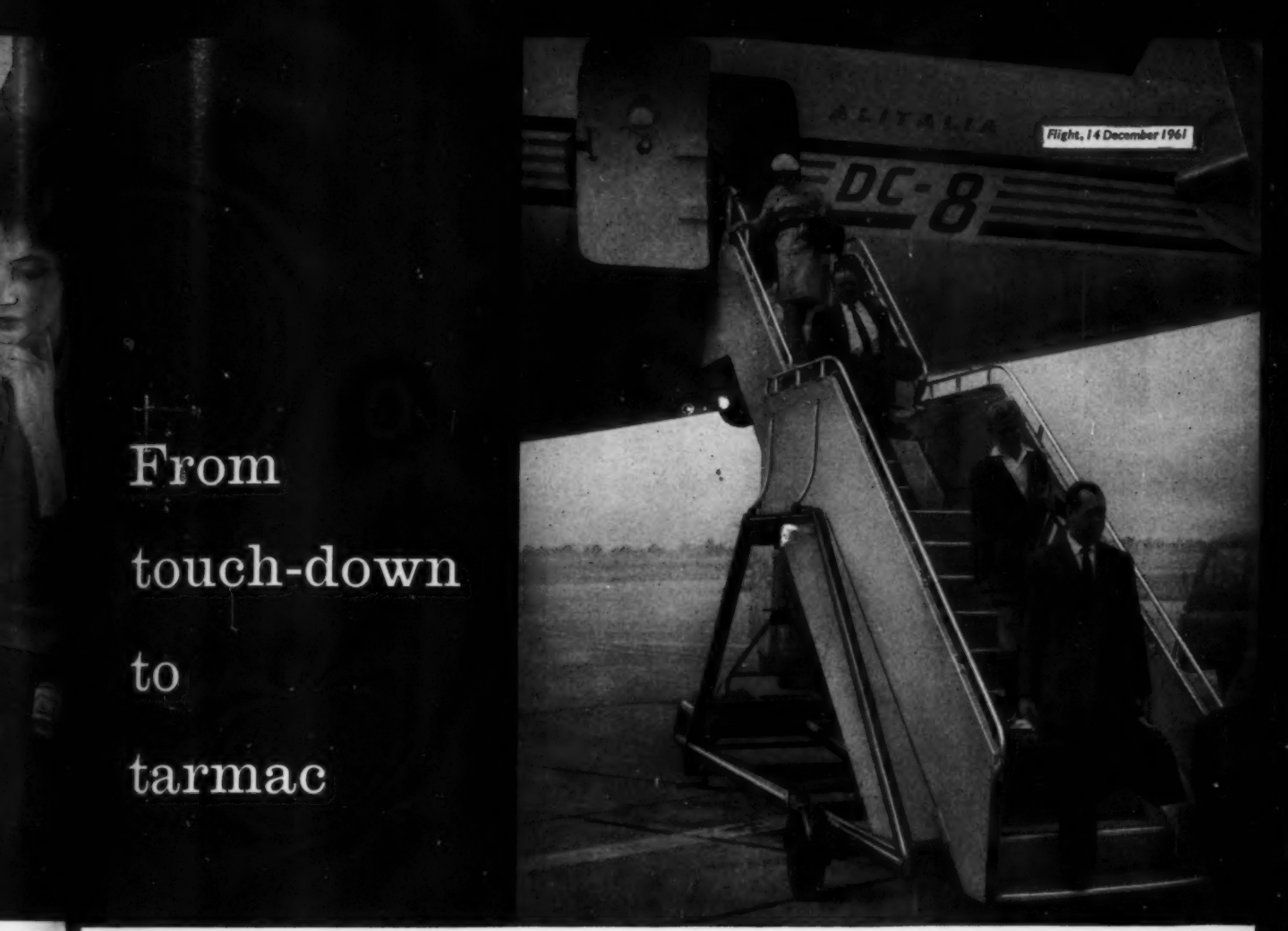

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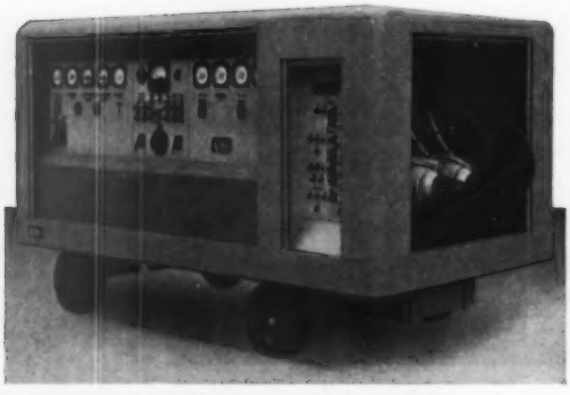

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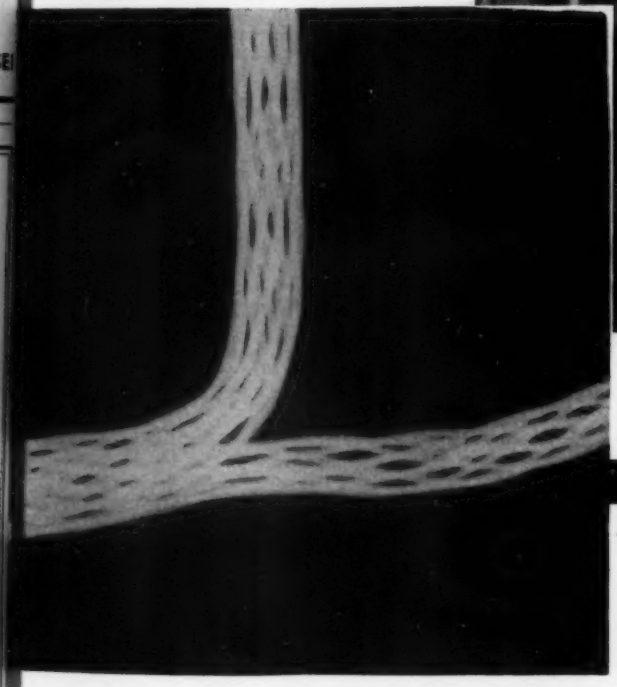

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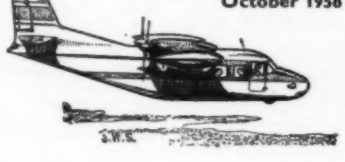

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DUTIES: Supervise the activities of technical staff on a microwave tracking radar and associated digital data equipment. **QUALIFICATIONS:** Appropriate degree or equivalent academic qualifications. Experience in the fields of radar, pulse techniques, or digital data transmission and recording an advantage.

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DUTIES: Undertake the development and modification of equipment required to measure the ozone concentration in the earth's atmosphere and participate in experiments using such equipment. **QUALIFICATIONS:** For this position a degree or equivalent qualifications in Chemistry is required and the applicant should have an interest in electronics. Qualifications in electronics or physics would be acceptable if coupled with an interest in chemistry.

NOTE: (i) For Salisbury positions assistance will be given in obtaining married accommodation.
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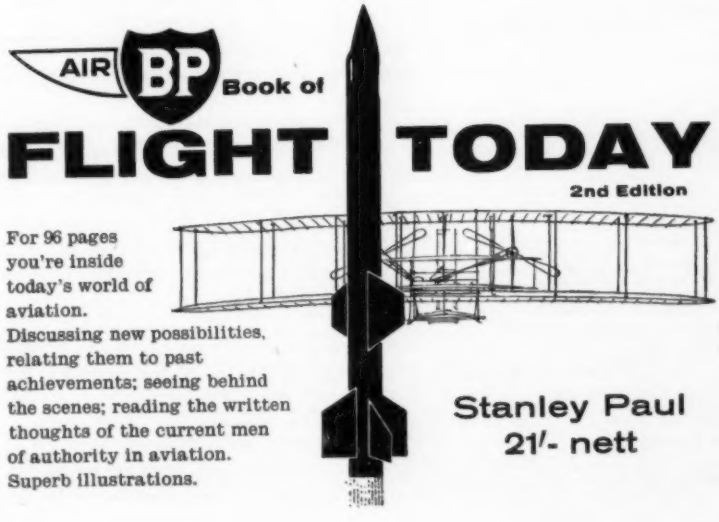
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Please quote reference B13/5/1 when enquiring. [2634

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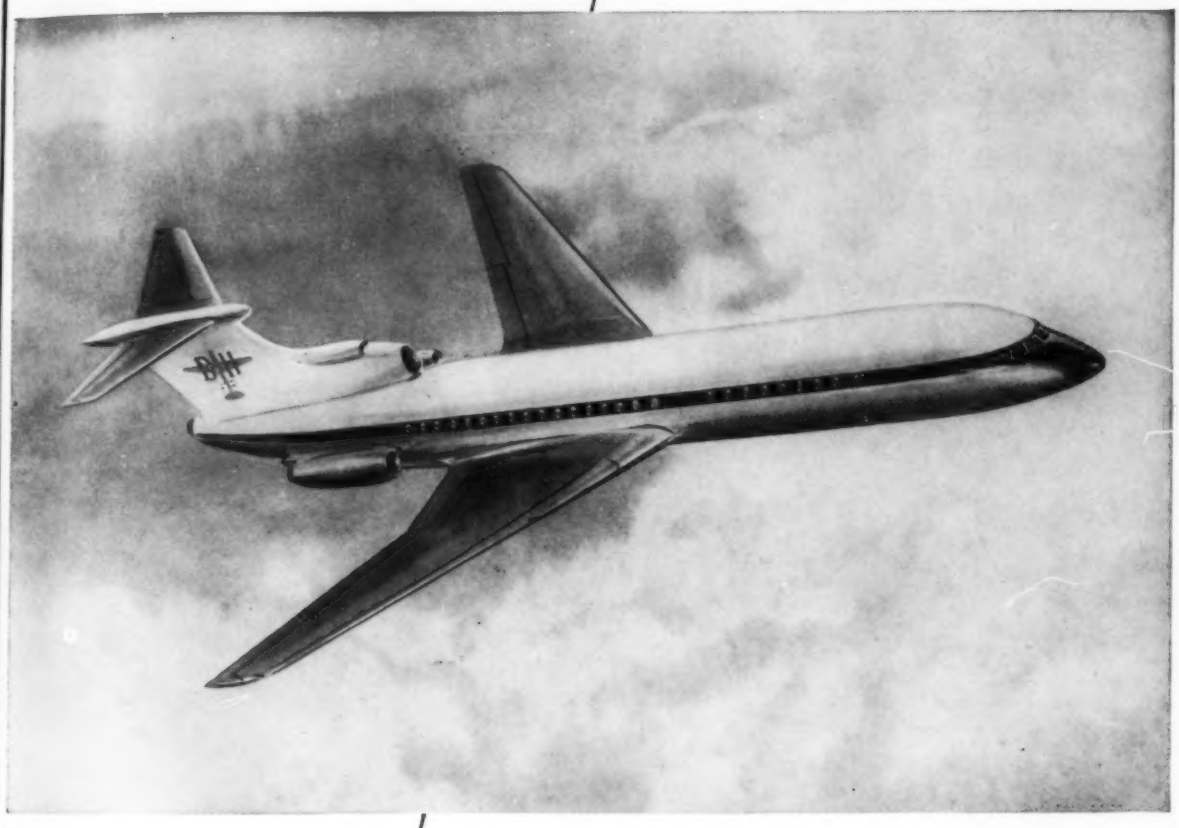

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